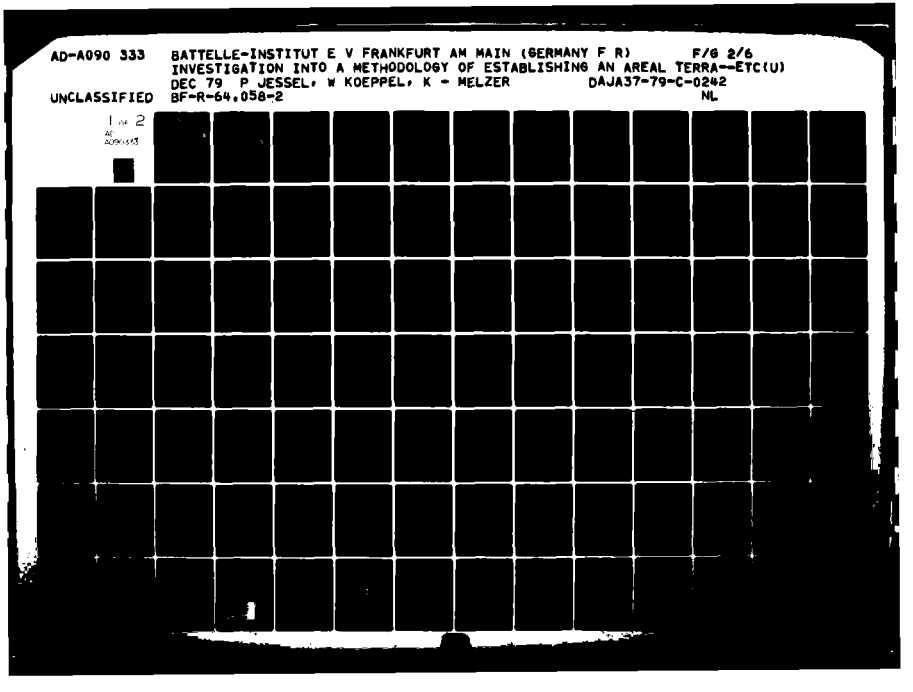
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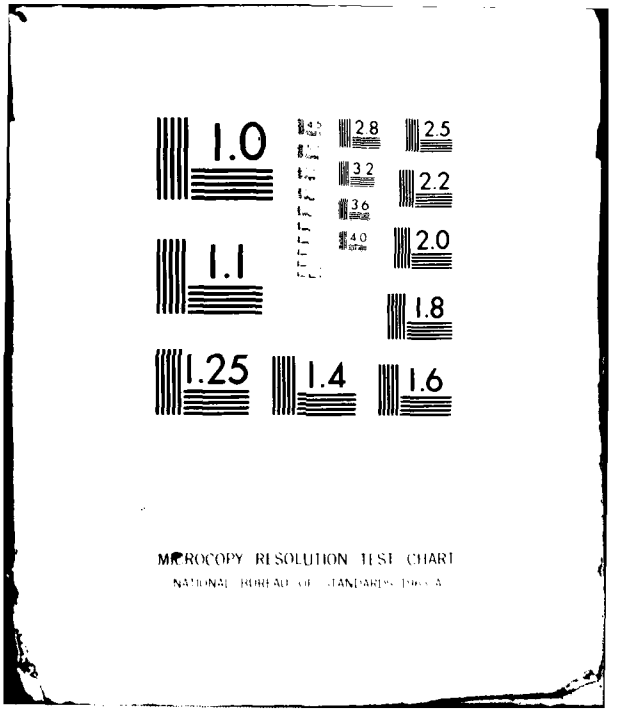
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LEVEL II

Report

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Battelle

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DAJA 37-79-C-0242

Investigation into a Methodology of Establishing an Areal Terrain-Data Base

Phase III

BF-R-64.058-2

INVESTIGATION INTO A METHODOLOGY OF ESTABLISHING AN AREAL TERRAIN-DATA BASE

PHASE III
(Report No. 2)

Final Technical Report
by

P./Jessl
W./Köppel

December 1979

EUROPEAN RESEARCH OFFICE
United States Army
London England
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F O R E W O R D

The study reported herein was conducted by Battelle-Institut e.V. (BIeV), Frankfurt am Main, FRG, on behalf of the USAE Waterways Experiment Station, CE, Vicksburg, Miss. (WES), under a contract from the US Army European Research Office, London. It is part of joint efforts by WES and BIeV to evaluate and improve the reliability of existing terrain data acquisition methods (e.g. /1/) at WES.

Under the current research contract (DAJA 37-79-C-0242) "Investigation into a Methodology of Establishing an Areal Terrain Data Base", BIeV published a report subtitled "Phase II"; as the research program has been restructured by ERO London, this report will be specified as report No. 1, while the study reported herein represents report No. 2. Further studies will be numbered consecutively as report No. 3, etc.

The personnel participating in the vegetation field work included: P. Jessl, W. Köppel and H.V. Wünscher, Automotive Engineering Section (BIeV). Forest inventory and stand table data were acquired and reduced by P. Jessl and W. Köppel. Dr. Röding (Hessian Institute of Forest Management, Giessen) provided the necessary maps and information on forest management regimes. The report was written by P. Jessl and W. Köppel. K.-J. Melzer was the principal investigator.

A B S T R A C T

This volume contains a compilation of vegetation field data, statistical stand table data and current forestry inventory data for a selected area of the FRG within two 1 : 50,000 scale quadrangle sheets Lauterbach (L 5322) and Hünfeld (L 5324). The data were used for assessing the applicability of existing vegetation terrain data modeling at the WES and necessary improvements. For these purposes, the four dominant German forest species (beech, oak, pine, spruce) were investigated. An approach was made to analyze current inventory data from forestry management books for selected compartments, modifying stand table data from statistical data sources plus investigating some selected field sites according to the common WES vegetation sampling procedures. Finally, a first evaluation on the feasibility of aerial photo interpretation was made for selected species found in West German forests. General procedures for predicting vegetation characteristics were derived for the species investigated.

Key words:

Vegetation terrain data
Mobility
Terrain modeling

PART I: INTRODUCTION

Background

A major condition for the reliable prediction of a vehicle's mobility operating on a specific terrain is sufficient knowledge of the various terrain features encountered. Because of the extremely high cost involved, a complete ground truth data collection for mobility assessment is not feasible. Therefore, it becomes necessary to develop and apply methodologies (e.g. /1/) which consider derivation of terrain data from existing sources, such as topographic maps, land-use maps, soil maps, forestry maps and aerial photographs. WES and BIeV have contributed to establishing and improving such methodologies through various efforts and studies /1, 2/. Because of highly developed management guidelines and small forest compartment sizes, the methodologies used in evaluating forested areas of the US. may not be applicable to the evaluation of forested areas of the FRG.

Purpose and Scope

The purpose of the study was to collect basic stand table data for selected species in the FRG and establish stem size-spacing relationships for the dominant and co-dominant species of a selected area. It had been intended to derive a vegetation analysis of FRG forests by reasonable estimates of stem size-spacing on the basis of data on species, forest height, age, tree per unit area and management regime. In order to accomplish these tasks, detailed information on forestry management, inventory data and stand tables plus field data were to be collected for a selected area (quad sheets L 5322, L 5324) in the Central Highlands of Hesse. Ninety forest compartments (units) were examined from current inventory sources, while 13 sites were sampled out of these various vegetation structures according to WES standard procedures

(Appendices A and B). Aerial photos of ten compartments were interpreted to allow a first careful assessment of the feasibility and effort involved in describing these vegegation terrain features.

PART II: SELECTION OF STUDY AREA

Area Investigated

The area selected for investigation was located within the two 1 : 50,000 scale quadrangle sheets L 5322 (Lauterbach) and L 5324 (Hünfeld) in the north-eastern part of the HIMO-strip (Fig. 1) within the Central Highlands of Hesse.

Forest Ownership

Within the state of Hesse a total forested area of 886,000 hectares (ha) are managed. Of these, 371,000 ha are state-owned, 306,000 ha corporationally-owned (i.e. municipal forests) while 32,000 ha belong to several private groups (called joint ownership forest) and 177,000 ha are private forests (see Fig. 2).

Management Scheme

Management is organized by the Ministry of Forestry of Hesse and implemented by 113 state forestry offices, 20 private forestry administrations and 4 private forestry offices. Each office manages an average area of approximately 7,000 ha which is then under the responsibility of about 7 district offices (see Fig. 3). Assuming an average compartment size of 5 ha each, one district forestry office will manage about 200 different units of vegetation (compartments). From such offices "Current Forestry Inventory Data" were obtained for the study reported herein.

Species Encountered

Within the Lauterbach and Hünfeld quad sheets approximately 60 percent and 35 percent, respectively are forested. This makes about 50 percent forested area for both quad sheets. Of this, 47 percent is under state ownership, 41 percent private forests and 12 percent municipal forests (see Fig. 4). Four forestry offices manage about 80 percent of the study area or approximately 5,600 compartments (see Fig. 5). Each of these compartments or units has some particular properties with respect to geological, topographical and soil aspects.

It has to be mentioned here that forestry authorities assign all associated or subspecies to the four dominant species. However, the associated species constitute approximately less than 5 percent for each dominant species, which does not call for separate recording. Fig. 6 shows the dominant and associated species for West Germany, while Fig. 7 depicts the distribution of species within the area associated with each of the dominant species investigated.

For the study area the frequency distribution for the dominant species is shown in Fig. 8 and for the entire FRG in Fig. 9, and is tabulated below.

Species	Frequency (%) of Occurrence for the	
	Entire FRG	Area of Investigation (L 5322/L 5324)
oak	7	3.4
beech	23	21.5
spruce	43	21.5
pine	27	53.6

The tabulation shows that the distribution of pine in the area investigated is about twice that in the entire FRG, spruce and oak about one-half and beech about equal.

Bedrock and Surface Soil Types

Four types of bedrock have been encountered within the area investigated. A broad qualitative classification is shown in Fig. 10. These rocks make up approximately 80 percent of the total area. New red sandstone covers about 60 percent, limestone 20 percent, basalt 10 percent and quartzite rock approximately 10 percent of both quad sheets. Basalt peaks occur within both limestone and sandstone areas (see Appendix C). The surface composition results in a predominance of clayey silts (ML) covering the limestone, while sands and silty sands (SM) are found on sandstone, quartzite and basalt. Clayey silts (ML) are superposed on the basalt peaks (see Fig. 10 and Appendix D).

Regarding the bedrock composition and related tree species for both quad sheets, some major associations can be identified. On the Hünfeld quad the large limestone areas are favorable for beech trees while these are rather rare within the adjacent western quad, Lauterbach. Red sandstone in the Lauterbach quad favors the predominant growth of pines and spruces (see Figs. 11, 12, 10). These relations are quite remarkable when examining the areas of the Hünfeld and Schlitz forestry offices.

Limestone and basalt covers approximately 55 percent and red sandstone 45 percent of the actual area for the Hünfeld office. Beech and pine trees occur almost equally with frequencies of 36.7 and 37 percent (see Fig. 13). Typical beech stocking also occurs on basalt peaks within the area.

However, most of the area managed by the Schlitz forestry office is red sandstone (96 %) and the remaining area is limestone and

basalt (4 %). Consequently pines and spruce (54 % and 24 %, respectively) dominate here, while beech make up 19 percent and oak 3 percent (Fig. 14).

PART III: STATISTICAL VEGETATION DATA

Stem Size-Spacing Relations for Dominant FRG Forest Species

Literature data sources which are useful in describing average stem size-spacing relationships for the dominant German forest species - oak, beech, pine and spruce - are comprehensively available in /3/, including additional information on some associated species. This data source is called "Statistical Vegetation Data" in this report.

Stand Tables

The tabulated data shown in /3/ were the main constituent of stand tables to be compiled later in this report. These data were first published in 1912 and are the result of long-term observations of testing areas for the various species of interest. They are continuously being reexamined and corrected, if necessary, by the forestry research institutes concerned. They are the only reliable source available that provides average growth development of forest compartments based on long-range growth observations. Five characteristics were utilized from the tables in the investigations conducted. Starting with an age of 20 to 30 years up to the various cutting ages with a 5 years time increment, and for a given "locality class" and "method of thinning", values for

heights (ft)
stem diameters (in) and
minimum stem spacing (ft) +)

were tabulated for each species (Tables 1, 2, 3, 4).
As all data within these tables represent average values (heights, stem diameters, spacing) it was not possible to make direct use of these data for establishing stand tables showing cumulative stem size-spacing relationships for given height, age and locality classes.

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*) Minimum stem-spacing data were computed by $\sqrt{\frac{4}{\pi}\frac{1000}{N}}$ using number of stems per ha from the original tables.

Locality Classes and Methods of Thinning

Locality classes evaluate the general growth in height and thickness (stem diameters) of the trees. They are not defined in a quantitative way by forestry authorities. Class I stands for extremely good, class VI extremely bad growth conditions. Up to six locality classes are given for the various species investigated.

Methods of thinning are split into moderate and heavy thinning. Both thinning techniques are not quantitatively specified within forestry guidelines, again. However, Schober's tables /3/ indicate some guidance in the management of various species resulting from long-term experience of forest experimental institutes. Generally, thinning may improve growth of best trees (positive selection) or remove ill ones (negative selection). Types of thinning may be further subdivided into:

- low thinning (thinning in the understory)
- high thinning (thinning in the overstory)
- plenter thinning

Low thinning aims at a single-storied stand and removes all retarded trees.

High thinning aims at an even-aged multy-storied stand by retaining the majority of the understory for soil improvement and removing overstory trees which are endangering choice trees.

Plenter thinning aims at a constant stem diameter by removing oversize trees and favoring better low-sized stems. Generally, it results in an even-sized and even-height stand.

Moderate or heavy thinning can be applied to all locality classes. Heavy thinning generally raises the average stem diameter for all species (theoretically) for about 1 to 1.5 inches. At early ages, heavy thinning procudes stem diameters that are extremely high at the cutting age.

PART IV: CURRENT FORESTRY INVENTORY DATA

Selection of Sites

While selecting sites of interest from this data source (obtained from the forestry offices of the study area) the following criterion (which represents a broad variety) was applied: dominant species, age and composition of associated species. Forest compartments were chosen for ages of 20-40, 40-70, 70-100 and 100-150 years. Data from these sources are called "Current Forestry Inventory Data" in this report.

Single species forests are rarely found in Germany. Within the study area, working criteria were set up with a dominance limit of 75 percent to be called single species forest. Mixed forests are characterized by a mixture of species where the dominant species is less than 75 percent. According to forestry office information the following mixed forests are to be generally encountered within the area of investigation:

- pines with beeches
- beeches with larches
- beeches with larches and pines
- beeches with larches, pines and spruces

The above sequence of species also defines the respective magnitudes of species' shares for the mix.

Mixed Stands

The German forestry authorities distinguish between even-aged and uneven-aged mixed stands while classifying mixed forests. Explanations are given below /4/.

The even-aged mixed stands are split into mixes of several species that are shade-tolerant like spruce-beech in Northern Germany and species that cannot tolerate shade, i.e. pine-oak, pine-birch, and mixes of the two, i.e. spruce and beech together with pine, oak and larch. Slow growing species that do not tolerate shade will always be naturally eliminated by shade-tolerant trees.

Mixed stands with areal mix or patch mix are growing just like pure stands. However, all stands are not only dependent on their height increments but also on site factors and thinning methods.

The uneven-aged mixed stand can increase the volume yield of compartments, however it strongly depends on favorable site conditions. While planning such a mix the following species are used as understory: beech, spruce, white fir and larch. The growth of these is mainly influenced by lack of sunlight, reduced assimilation, reduced frost, and lack of nutrients and water. Shade-tolerant overstory (beech, spruce) extremely restrics the growth of understory, especially stem diameters (see photo 1). Beech understory in pine forests is mainly to improve soil conditions. Generally, beech and spruce are the most important constituents of understory species for the German forests associated with pine and oak as overstory trees.

Forest Office Inventory Data

Each forestry office maintains a management book which contains detailed information for each compartment of the office's responsibility. Within the book, compartment data are stored for the entire life cycle which comprises information on the following:

- function (production goals, protective goals)
- site conditions (altitude, soil, slope, etc.)
- stand (species, understory, silvicultural needs)

- planning (logging schedules, limbing etc.)
- executional details (see Fig. 15 a/b)

Data for our purposes were mainly selected from site conditions and stand information and reduced to a format according to Fig. 16. Site data of nutrient supply, slope, water economy and canopy closure are classified by the forest authorities according to Fig. 17.

Data were taken from forestry offices at Grebenau, Schlitz, Burghaun and Hünfeld. These offices are managing approximately 80 percent of the total forested area within both quad sheets (see Fig. 5). According to most recent Hessian forest management procedures each office has to record compartment data in a standardized format applying ten-year periods for recording of current statistical changes. Extracted data were primarily from the last recording step in January 1975. However, Hünfeld data were taken from 1962 records. Ninety sites were investigated for five different forest types (4 dominant tree species plus mixed forests) (Appendix A). Figs. 18 and 19 depict the location of the sites.

Testing of Statistical Data by Current Inventory Data

Generally, stem diameters and stem spacing were not recorded in the management book. Thus, comparisons were based on age and height of the dominant species. By extracting data from the management books and inserting it into the statistical stand table data (Tables 1 to 4) comparisons were developed for each of the four species (oak, beech, pine and spruce). For that purpose, Tables 1 to 4 were converted into graphs indicating height versus age for appropriate locality classes and thinning intensities, then adding the inventory data (see Figs. 20, 21, 22 and 23) for each species. Compared to the statistical stand table curves, current inventory data fit quite well within the boundaries of

the selected statistical curves. It can be concluded that the current inventory data agree with the statistical stand table data by species, age, height and locality class. Also, this applies to mixed stands, when considering the dominant species of the mix. Therefore, each boundary curve represents a true average relation for each of the locality classes and thinning techniques, as shown for each of the selected forest species.

For the oak compartments investigated, most of the heights showed lower locality class values (locality classes II and III, i.e. growth conditions for heights and average stem diameters were comparatively poor); however, these results fit well into the given relationships (Fig. 20).

The majority of the beech sites selected also indicated poor locality classes (between classes II and III). For ages above 100 years the heights drop remarkably down to locality class III As these inventory data values do not exhibit poor site factors, this indicates decreasing accuracy for the table data when reaching high ages (Fig. 21).

For pine trees, heights were equally scattered across the given variations (Fig. 22).

Finally, spruce trees show a similar behavior as pines where heights are found equally scattered across the given band, too (Fig. 23).

PART V: FIELD DATA SAMPLING

Selection of Sites and Data Acquisition

In order to verify the usefulness of the statistical stand table data and the inventory data collected by the forestry management offices for describing forested areas for mobility evaluation, it was felt necessary to select some sample sites to produce vegetation field data using the WES sampling procedure for quantifying vegetated terrain. These were compiled in order to allow assessment of some typical pure stands. Additional vegetation data are available from other terrain data investigations of WES and BIeV, but are not used here. For this evaluation, 13 sites were selected within the Lauterbach and Hünfeld quad sheets (Fig. 24). Sites were selected based on dominant species and a range in age of each species, to sufficiently allow comparisons between statistical and current forestry inventory data and the field data sampled according to WES procedures. Sites sampled were in 3 oak, 2 beech, 2 spruce, and 6 pine compartments. Vegetation data were recorded according to the WES terrain data acquisition procedures and forwarded to WES on 10 September 1979 (see Appendix B).

Comparison of Statistical Stand Tables, Current Inventory Data and Field Data

The available data sources were used in the following manner: in a first step, the minimum stem spacing data for the compartment sites visited (field data) were plotted for each species in a graph depicting minimum spacing versus the average diameter of all stems within the sample (e.g. Fig. 25).

As a limit within these graphs the statistical stand table data /3/ were plotted for each species and associated locality class for both methods of thinning in an envelope format (e.g. Fig. 25).

This was done by depicting the extreme curves - the best class I and the poorest class III - plus the end point of class II and connecting the end points of classes I and III together with end point II. Thus, a final enveloped area is obtained which will cover all statistical data values for the particular species and method of thinning applied. These results are shown on Figs. 25, 26, 27, 28; it is important to note that for each species and thinning method, the band width increases with increasing growth and/or age because the decrease in trees per unit area decreases more rapidly for the better locality classes than for the poorer ones. The coniferous trees are harvested at an earlier age at which time their average diameter and minimum spacing is less (or trees per acre is greater) than in the case of the deciduous trees (Fig. 29, 30).

Because of lacking availability (access) of pure oak sites pure oak stand samples were limited to only one. The other samples shown on the graph (Fig. 25) qualify as mixed forest which explains their greater deviation from the statistical data than the one pure site. Oaks will reach the biggest stem diameter and spacing per unit area because of their high cutting age of almost 200 years.

Regarding beech, this species will arrive at a cutting age of 150 years and an average spacing of 20 percent less than oaks (Fig. 26). Sites 3 and 5 fit well into the given band.

There are more pines found in the study area than any other species. Their cutting age is 140 years. Sites 16 and 86 correlate very well with the stand table data, while sites 14, 17, 20 and 87 do not fit with the bands shown.

Spruce has the lowest cutting age of 120 years. Site 12 fits into the high locality class band, while site 31 is located below the given band width (Fig. 28).

Considering the pure average characteristics of stand table data shown and the format needed for vegetation terrain data as input to mobility modeling (i.e. stem spacing versus stem diameter in a cumulative way for given ages, sites characteristics and heights) pure stand table data cannot be applied for the purposes required. The same applies to current inventory data, where stem diameters and stem spacing are not recorded at all.

When comparing the field data with the forest inventory data and the statistical data by minimum spacing, average stem diameter and locality class it can be concluded that for oak, one sample of pure oak is not sufficient to draw a conclusion. For beech, the data compares for all samples. For pine, only two of the sites agree with the forestry inventory data and statistical data. Considering spruce, one site agrees while another one does not (locality class was not identified in the forestry inventory data).

Thus, a combined approach using statistical stand table data, current inventory data and field data is proposed in the following paragraphs.

Vegetation Analysis

Vegetation characteristics should generally be predicted in the following way:

1. If possible, determine age and locality classes for the area of interest (i.e. of certain compartments) from current inventory data sources (i.e. forestry management books if available). Otherwise age and locality class have to be estimated as shown below.

2. Determine heights, stem sizes and stem spacings for the area of interest in the field according to the WES field sampling procedures.

3. Correlate age, locality class, height, stem size and stem spacing derived from 1. and 2. with the statistical stand table data sources. If necessary, carry out some interpolation procedures as inventory data (i.e. locality classes) do not always correspond satisfactorily with field data and associated values in the statistical stand table data sources.

Considering the most common and realistic case of processing pure vegetation field data, the procedure will be accomplished specifically as follows (e.g. for oak see Tables 1.1-1.3).

a) Stem heights H and diameters D are determined in the field according to the WES vegetation sampling methods. Stem diameters which are sampled in each of the 26 diameter classes (ranging from ≤ 1" to 100" are then averaged by computing

$$D_A = \sqrt{\frac{1}{N} \cdot \sum_{i=1}^{n} N_i \cdot D_i^2}$$

with N = No. of trees within the sample
N_i = No. of trees within each diameter class
D_i = Class diameter or class midpoint
n = No. of diameter classes

b) Enter Table 1.1 with height H and determine a suitable age for each locality class and both thinning methods.

c) Enter Table 1.2 with average diameter D_A and read off a suitable age for each locality class and both thinning methods.

d) With two ages available for each locality class and associated thinning method the best corresponding ones are chosen from (b) and (c) and averaged to age A.

e) Taking A and the actual height H the final locality class is now read off from Table 1.1, again by interpolation.

The procedure may be extended in such a way that, additionally, from field sampling activities a stem spacing value is averaged as SS_M for the entire sample area and processed in step a). Thus, step c) may be accomplished in accordance with Table 1.3 and confirm the selected locality class or necessitate some reexamination. Finally, the procedure may be repeated by using SS_M and D_A as field input data.

To give an example for the latter case of processing pure vegetation field data, site No. 87 (pine forest) within the Grebenau forest office compartments may be examined in the following way (the given age known from current forestry inventory data is omitted for demonstrating the most common data reduction procedure, if age is not available):

a) Stem height H is directly determined in the field while average diameter D_A is developed from the vegetation field data sheet recorded.

Both values are H = 89'

and D_A = 12.4" (see Appendix B)

$$(D_A = \sqrt{\frac{12\times4^2 + 12\times5^2 + 8\times7^2 + 4\times8^2 + 4\times9^2 + 76\times12.5^2 + 10\times17.75^2 + 6\times25^2}{132}} = 12.4")$$

b) Entering Table 3.1 with H = 90' results in age-locality class arrays for both thinning methods:

Heavy Thinning

Locality Class	I	II	III	IV	V
Age	90	137	> 140	-	-

Moderate Thinning

Locality Class	I	II	III	IV	V
Age	95	140	> 140	-	-

c) Entering Table 3.2 with D_A = 12.4" will yield two age-locality class arrays again:

Heavy Thinning

Locality Class	I	II	III	IV	V
Age	81.2	96.0	116.3	> 140	-

Moderate Thinning

Locality Class	I	II	III	IV	V
Age	86	103	125	> 140	-

d) The best corresponding ages are 90 and 81.2 years for locality class I and heavy thinning (slightly better than locality class I for moderate thinning). Averaging these ages produces A = 85.9 years.

e) Taking A = 85.9 years and H = 90', a most probable locality class slightly better than I for heavy thinning can be read off from Table 3.1 by interpolation: 85.9 years yield a height of 88.1' for locality class I (heavy thinning).

Extending the procedure in such a way that a stem-spacing field value is introduced as SS_M the following results are obtained:

a) Minimum stem spacing SS_M for all trees of the sample area is given as $SS_M = \frac{D}{\sqrt{N}}$ with D = Sample diameter
N = No. of trees within the sample area

$$SS_M = \frac{200}{\sqrt{132}} = 17.4'$$

b) The two age-locality class arrays for H = 90' were given (see c) as:

Heavy Thinning

Locality Class	I	II	III	IV	V
Age	90	137	> 140	-	-

Moderate Thinning

Locality Class	I	II	III	IV	V
Age	95	140	> 140	-	-

c) Entering Table 3.3 with SS_M = 17.4' will yield the following age-locality class arrays:

Heavy Thinning

Locality Class	I	II	III	IV	V
Age	68.6	80	93.3	111	140

Moderate Thinning

Locality Class	I	II	III	IV	V
Age	83.6	97	110	131.3	>140

d) The best corresponding ages are 83.6 and 95 years for locality class I and moderate thinning which differs by thinning techniques from the above results gained by stem size information during step c). An average age of A = 89.3 years can be chosen.

e) Taking 89.3 years and H = 90', a most probable locality class slightly better than I for moderate thinning can be read off from Table 3.1 by interpolation: 89.3 years yield a height of 87.8' for locality class I for moderate thinning.

Finally the procedure may be repeated by using minimum stem spacing SS_M and average stem diameter D_A. The following results are obtained:

a) D_A = 12.4"
SS_M = 17.4'

b) Entering Table 3.2 with D_A = 12.4 " yields the following age-locality class arrays:

Heavy Thinning

Locality Class	I	II	III	IV	V
Age	81.2	96.0	116.3	>140	-

Moderate Thinning

Locality Class	I	II	III	IV	V
Age	86	103	125	>140	-

c) Entering Table 3.3 with SS_M = 17.4' results in:

Heavy Thinning

Locality Class	I	II	III	IV	V
Age	68.6	80	93.3	111	140

Moderate Thinning

Locality Class	I	II	III	IV	V
Age	83.6	97	110	131.3	>140

d) Best corresponding ages are 86 and 83.6 years for locality class I and moderate thinning. An average age of A = 84.8 years may be chosen.

e) Taking A = 84.8 years and D_A = 12.4", a most probable locality class slightly better than I for moderate thinning can be read off from Table 3.2 by interpolation : 84.8 years yield a diameter of 12.3" for locality class I (moderate thinning).

Consistency for all predicted values seems to be quite sufficient, especially with regard to the fact that the site of investigation did not constitute a pure pine sample. This may affect the accuracy of the results derived from statistical pine stand tables.

The fact that different thinning techniques have been predicted does not necessitate a reexamination of locality class. Moreover, as current forestry inventory data indicate locality class I for that site, the above conclusions are confirmed. Fig. 31 shows the resulting locality classes and ages for all 13 sites visited predicted by processing field data on heights and average stem diameters, heights and minimum stem spacing as well as average stem diameters and minimum stem spacing in the way shown above.

Predictions confirm that integration of the WES sampling procedure is most adequate and a requisite for determining the required characterstics of forest species (stem spacing, stem diameter and locality class) most of which are lacking in the statistical and current inventory data bases.

PART VI: AIR PHOTO EVALUATION

Large-scale acquisition and mapping of vegetation terrain data obviously call for aerial photo interpretation in the data compilation process as this will ensure cost and time effectiveness. Aerial photo evaluation as a mapping tool can be extremely useful if combined with additional data sources, such as soil, geological, and land-use maps, ground truth sampling, etc.

Even 1:25,000 scale photos (orthoquads) will allow some preliminary forest type assessment. 1:12,000 scale stereo pairs are of course most suitable for evaluation. As an example, Figure 32 and Photo 2 show the preference for beech stocking on limestone bedrock. Fig. 32 shows the limestone within the red sandstone area on the geological map of Hesse (see also Appendix C) while Photo 2 depicts the entire beech stocking of that area on a 1:12,000 scale photo.

Adding the various forestry office maps of a 1:25,000 scale, forest compartments and forest trails are easily identified. An interesting data source in the Hessian forest offices is a forest trail network map which will allow for quick decisions on which of these trails are trafficable throughout the year for commercial trucks.

Prediction of Parameters for Some Sites Selected

Using a scanning stereoscope and a magnification of 4.5 x, various forest compartments were evaluated on 1:12,000-scale stereo pairs. Predictions were made for heights, canopy closure, composition and species. For the Grebenau forest office six compartments were examined (see Photograph 3), while four compartments were chosen for the Burghaun office (Photograph 4).

Inventory data were reported by the two offices later and are shown on Figs. 33 and 34. Height information were not recorded for compartments 123a, 123b and 119. Predictions for species, composition, heights and canopy closure are listed in Figs. 33 and 34.

Distinction between deciduous and coniferous trees does not cause major problems if the dominant species' share exceeds about 80 percent of the compartment. Generally, deciduous trees appear considerably brighter in tone. In the case of mature forests with an age over 80 years it proved to be rather easy to identify species after examining crown shapes - especially the typical round appearance of deciduous species. It should be possible to establish some translation routines for obtaining estimates of stem-size spacing after classifying crown diameters and heights for each compartment.

For younger mixed stands (less than 80 years) it was rather difficult to identify proportionate species. For these tone differences and crown shapes are not very distinct. Unique gray tone restricted reliable predictions. However, height and canopy closure were easily identified.

Evaluation of Methodology

Identification of species, height and crown diameter coupled with the statistical data should lead to an acceptable estimate of stem-size spacing. When this has been accomplished, air photo evaluation will replace field sampling. This is especially desirable when describing vegetation characterstics for large areas.

PART VII: CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Vegetation terrain data were compiled from three different sources: statistical stand tables, current forestry inventory books and field measurements. Considering the task of deriving stem-size spacing relationships for the dominant German species, the suitability of these data sources have been investigated. The ultimate objective of quantifying the vegetation in terms of stem-size spacing could not be accomplished because data were not readily available. The data available allowed the following conclusions to be drawn:

Current inventory data did well agree with statistical stand table data by species, age, height and locality class for both pure and mixed stands. A combined approach using statistical stand table data, current inventory data and field data has been proposed for quantifying vegetation parameters. Predictions of locality classes and ages for 13 sites showed satisfactory results when applying the above procedure. Evaluation of air photos for ten compartments allowed reliable estimates of species, height and crown diameter which should enable stem-size spacing assessment if combined with statistical data.

Recommendations

Vegetation field data on file at the WES and BIeV for the Central Highlands of Hesse, the Northern Plains and Southern Germany should be analyzed assisted by air photo evaluation. Although all dominant German forest species are within the investigated area, there is a basic need for such an analysis and additional vegetation terrain data sampling (WES standard procedures) within Northern and Southern Germany. Thus, the feasibility of the

proposed procedure for classifying large-scale vegetation terrain for the four dominant FRG species should be tested. During these efforts, stem-size spacing relationships will be obtained for the dominant species in three different geographical areas. After having identified the location of the compartments using forestry maps it is possible to complete sample site data by forestry inventory information on ages, locality classes, etc. (Appendices H-K).

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/2/ Koeppel, W.; Jessl, P., et al.: Investigation into a Methodology of Establishing an Areal Terrain-Data Base, Phase I. BF Report BF-R-63.783-1, Grant No. DA-ERO-78-G-101, March 1979

/3/ Schober, R.: Stand Tables of Important Species, 1975 (in German), J.D. Sauerländer's Verlag, Frankfurt a.M.

/4/ Wiedemann, E.: Silvicultural and Yield Basis of Forest Economics, 1960 (in German), J.P. Sauerländer's Verlag, Frankfurt a.M.

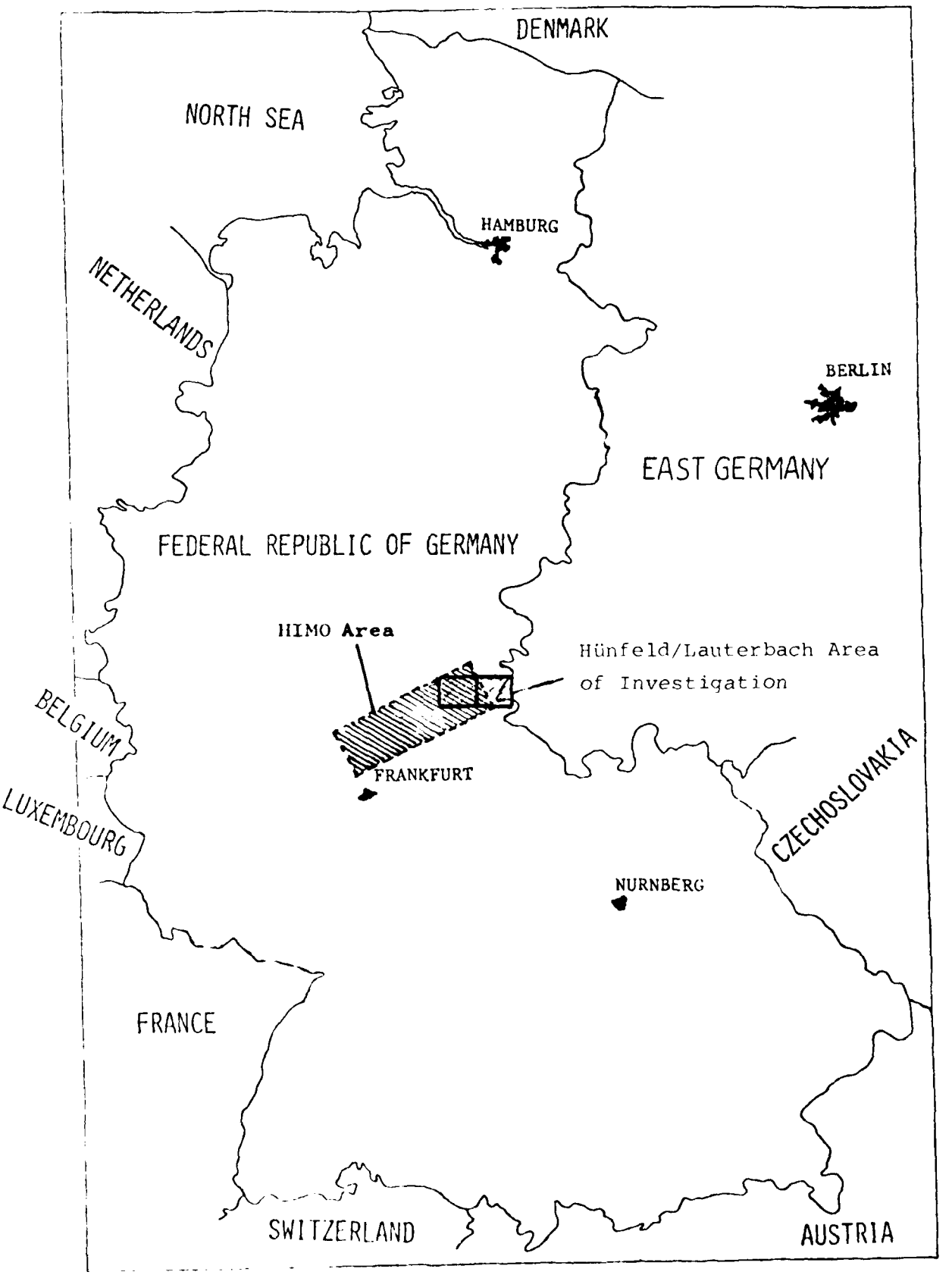

Fig. 1: Area of Investigation Within the FRG

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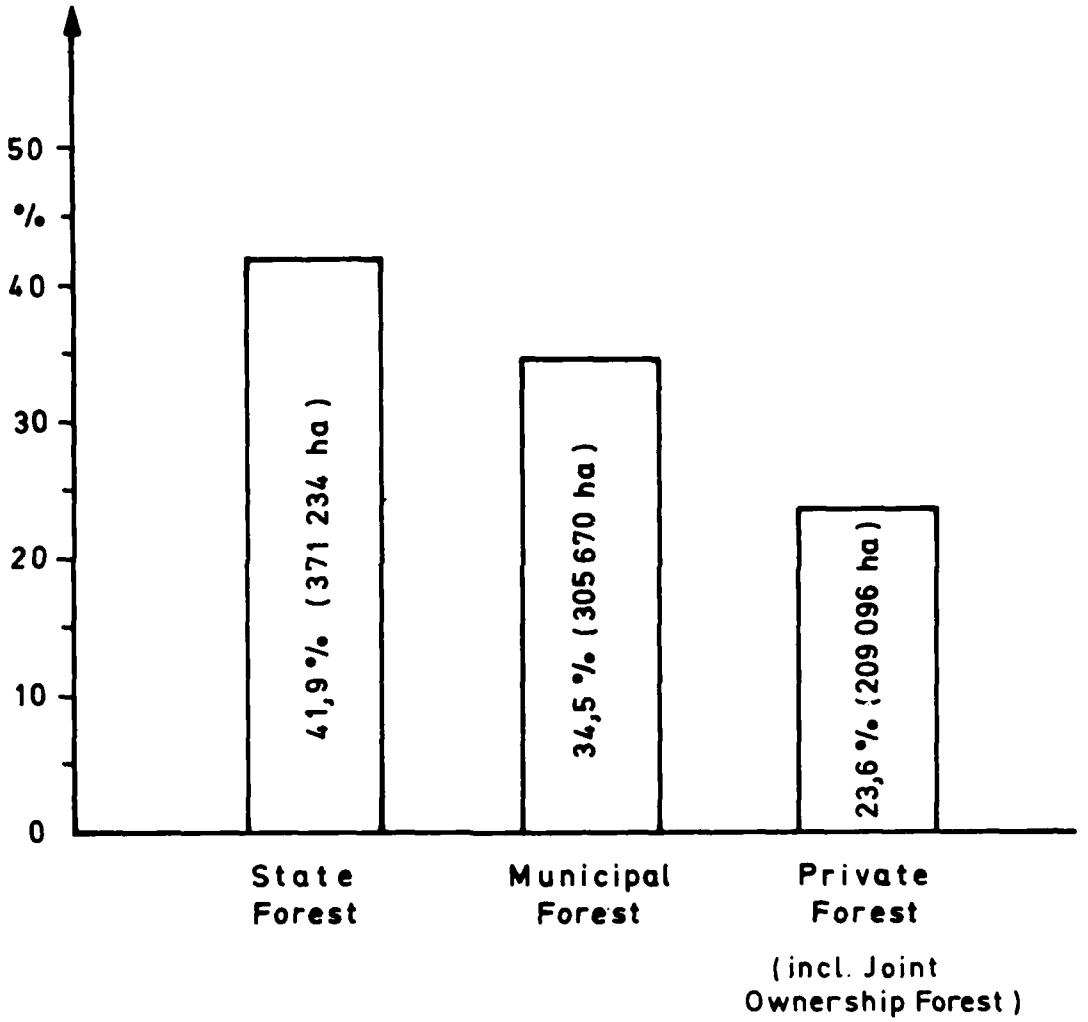


Fig. 2: Forest Ownership Conditions for the State of Hesse

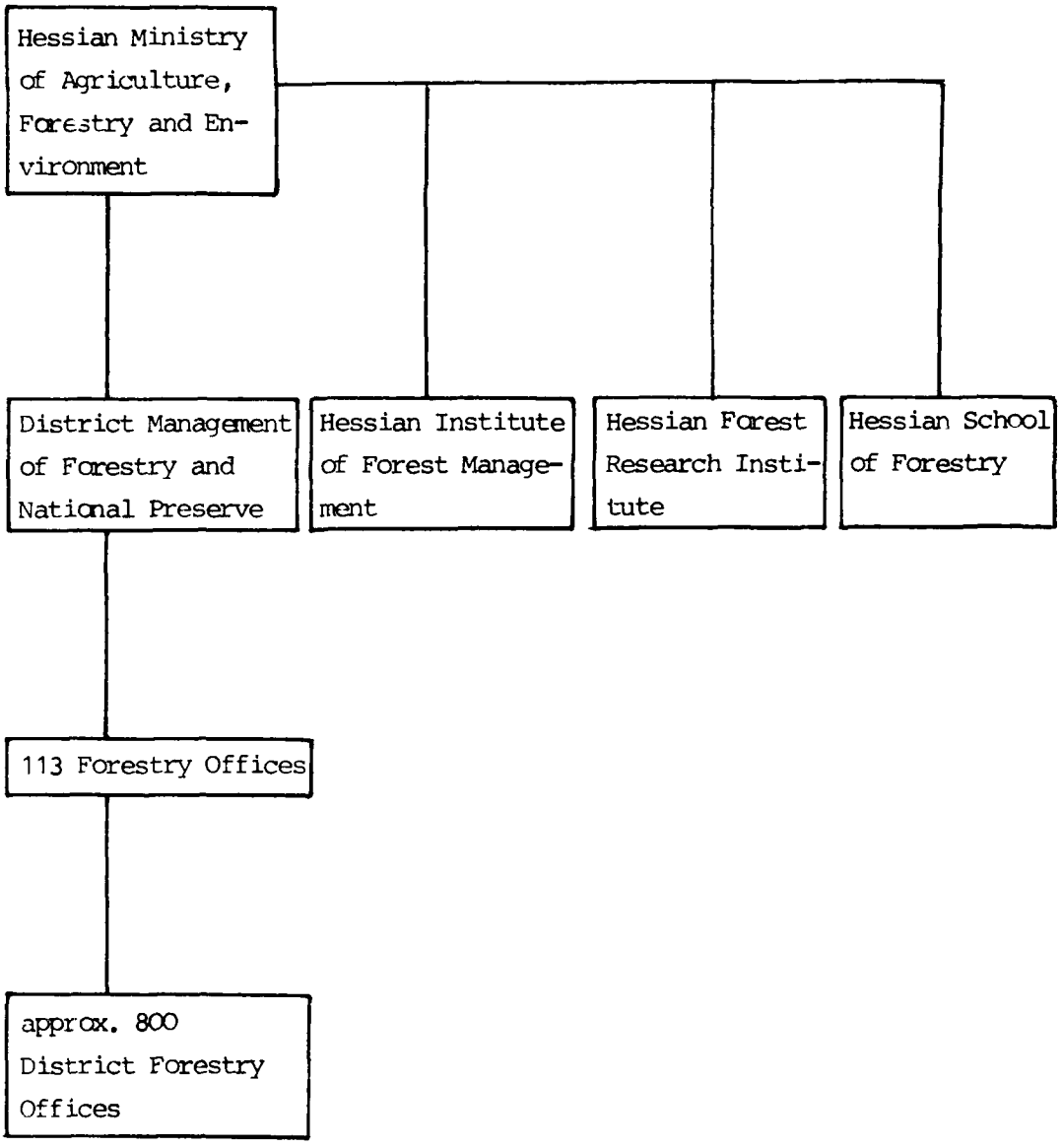


Fig. 3: Management Scheme for the State of Hesse

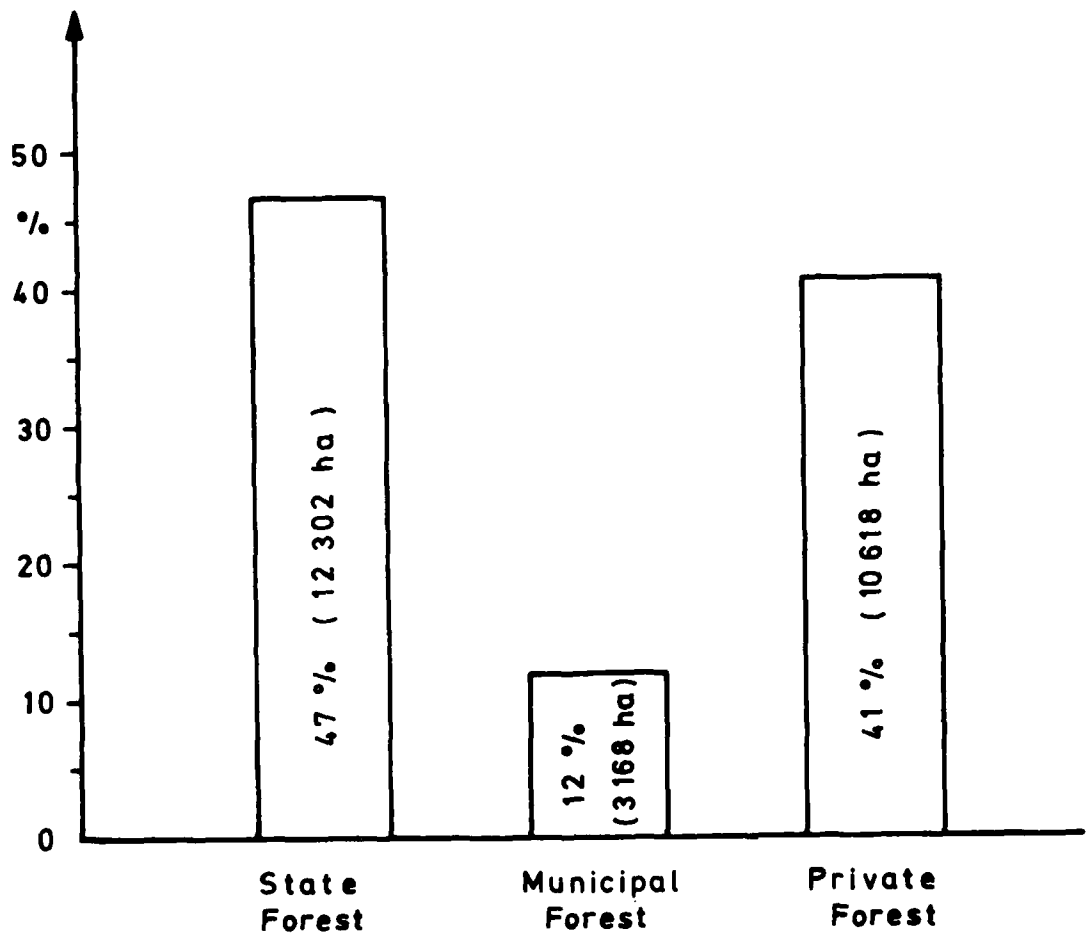


Fig. 4: Forest Ownership Conditions Within the Area Investigated

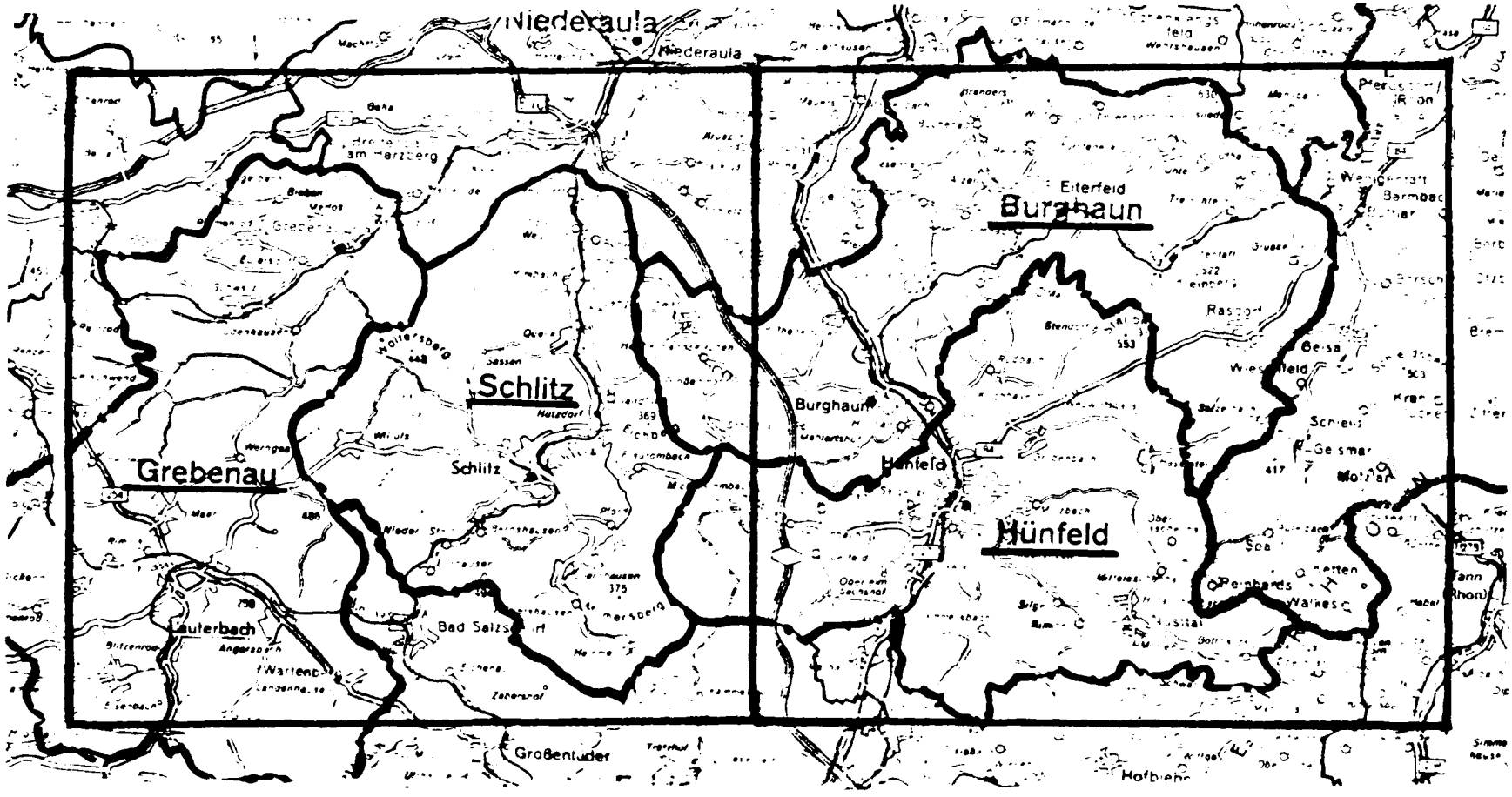


Fig. 5: Forestry Office Areas for the Area Investigated

Dominant Species	Associated or Sub-Species
Oak (querais petraea)	Red oak
Beech (fagus, silvatica)	Water beech, ash, maple, elm, birch, alder, lime tree, mountain ash, poplar, cherry tree, false acacia, asp
Spruce (picea abies)	Fir, douglas fir
Pine (pinus silvestris)	European larch, black pine

Fig. 6: Dominant German Species and Associated or Sub-Species

Dominant Species	Associated Species	State-Forests of								Average Percentage of Species
		Hünfeld		Burghaun		Grebenau		Schlitz		
		(ha)	(%)	(ha)	(%)	(ha)	(%)	(ha)	(%)	
oak	oak	197.2	97	59.5	92	82.3	94	72.3	97	96
	red oak	6.8	3	4.5	8	4.8	6	1.8	3	4
	Total Sum	204.0	100	64.0	100	87.1	100	74.1	100	100
beech	beech	1,059.7	96	269.5	90	622.9	98	501.8	97	96.5
	water beech	11.8		7.8		0.6		4.0		
	ash	43.3		4.8		0.7		0.2		
	maple	13.6		6.7		2.0		2.8		
	elm	0.2		0.1		0.1		-.-		
	false acacia	0.4		-.-		0.1		0.2		
	birch	18.4	4	5.6	10	0.3	2	3.9	3	3.5
	alder	9.1		1.4		3.4		2.5		
	asp	0.1		-.-		-.-		0.2		
	lime-tree	9.6		0.7		1.4		1.8		
	mountain-ash	0.1		-.-		-.-		-.-		
	poplar	1.0		3.8		0.4		0.7		
	Total Sum	1,167.3	100	300.4	100	632.1	100	518.1	100	100
spruce	spruce	712.6	97	260.4	97	1,146.5	95	640.5	97	97
	fir	0.6		1.4		9.7		3.0		
	douglas fir	17.6	3	7.3	3	26.3	5	12.3	3	3
	strobe	1.5		1.2		19.0		6.8		
	Total Sum	732.3	100	270.3	100	1,201.9	100	662.6	100	100
pine	pine	1,233.3	94	825.8	91	3.068.4	94	1.339.0	84	92
	larch	93.9	6	70.2	9	204.4	6	257.5	16	8
	Total Sum	1,317.2	100	904.9	100	3,272.8	100	1,596.5	100	100

Fig. 7:
Distribution of Species Associated with Each Dominant Species for the Area Investigated

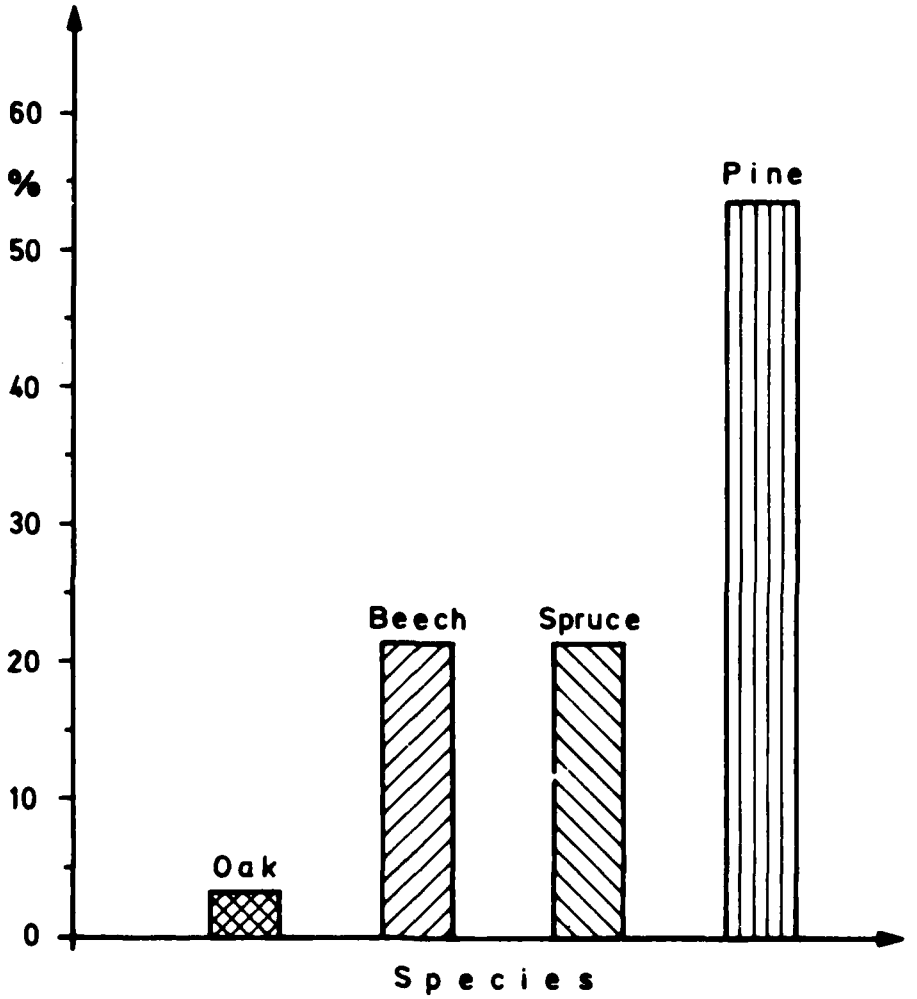


Fig. 8: Distribution of the Dominant Species for the Area Investigated

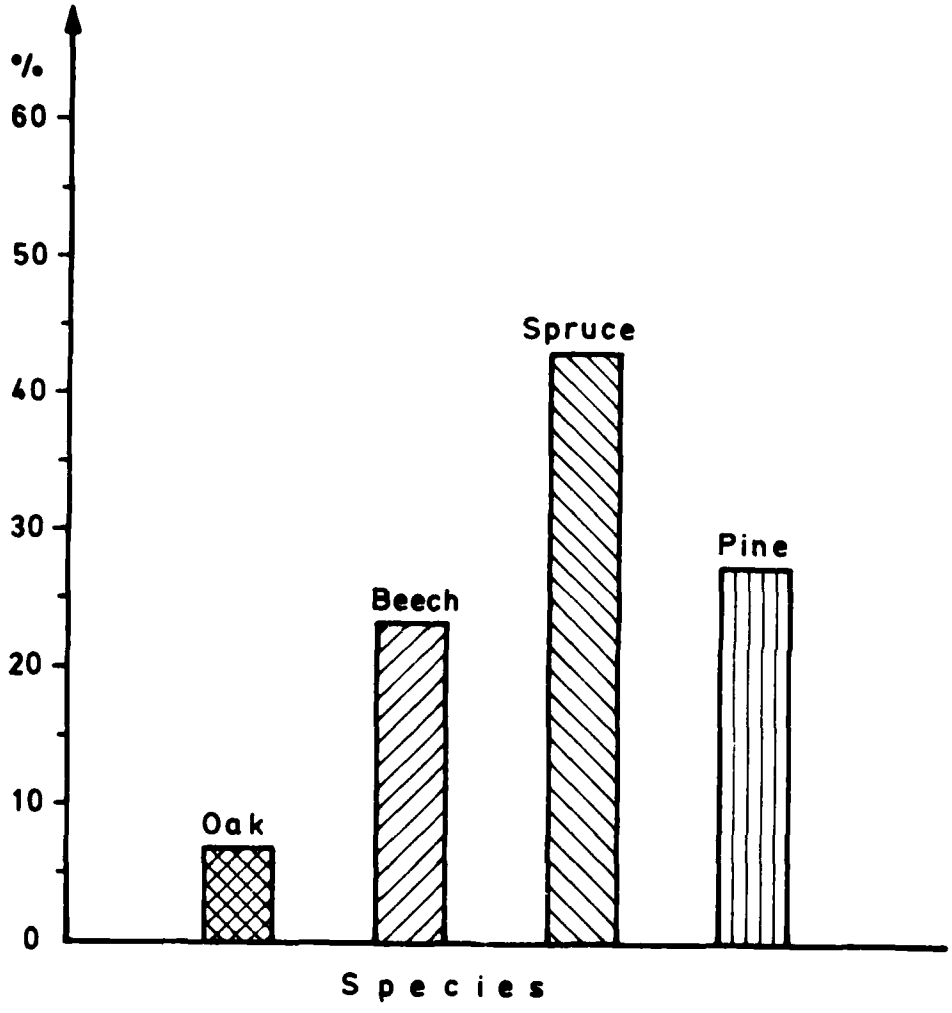


Fig. 9: Distribution of the Dominant Species for the Entire FRG

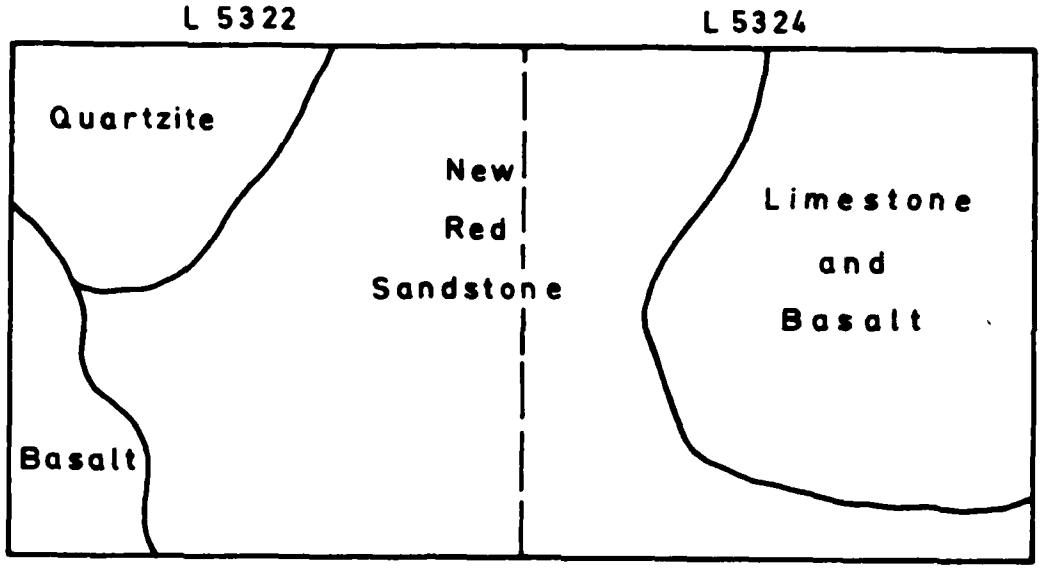


Fig. 10a: Types of Bedrock Within the Study Area

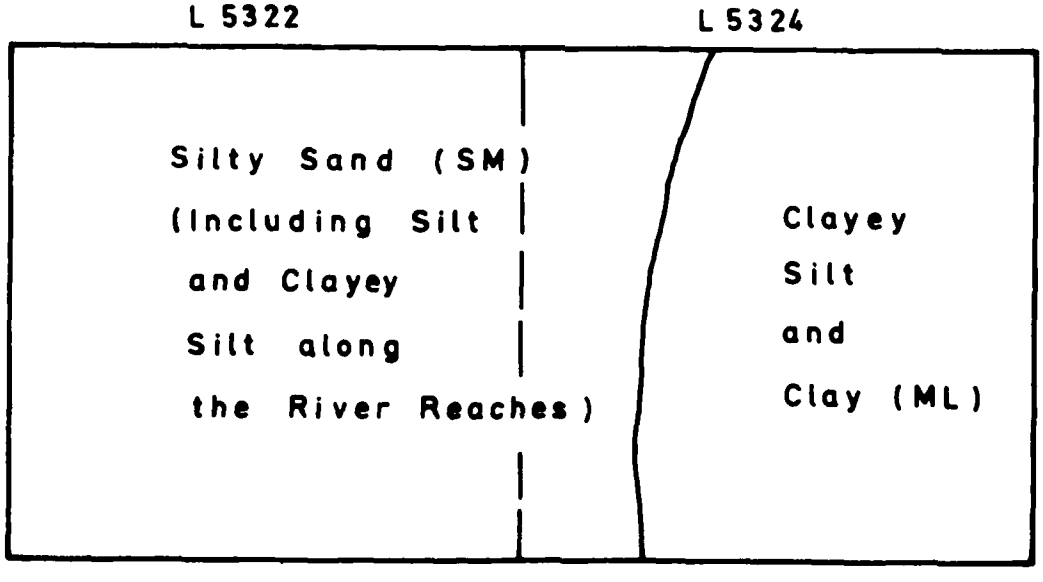


Fig. 10b: Surface Soil Types Within the Study Area

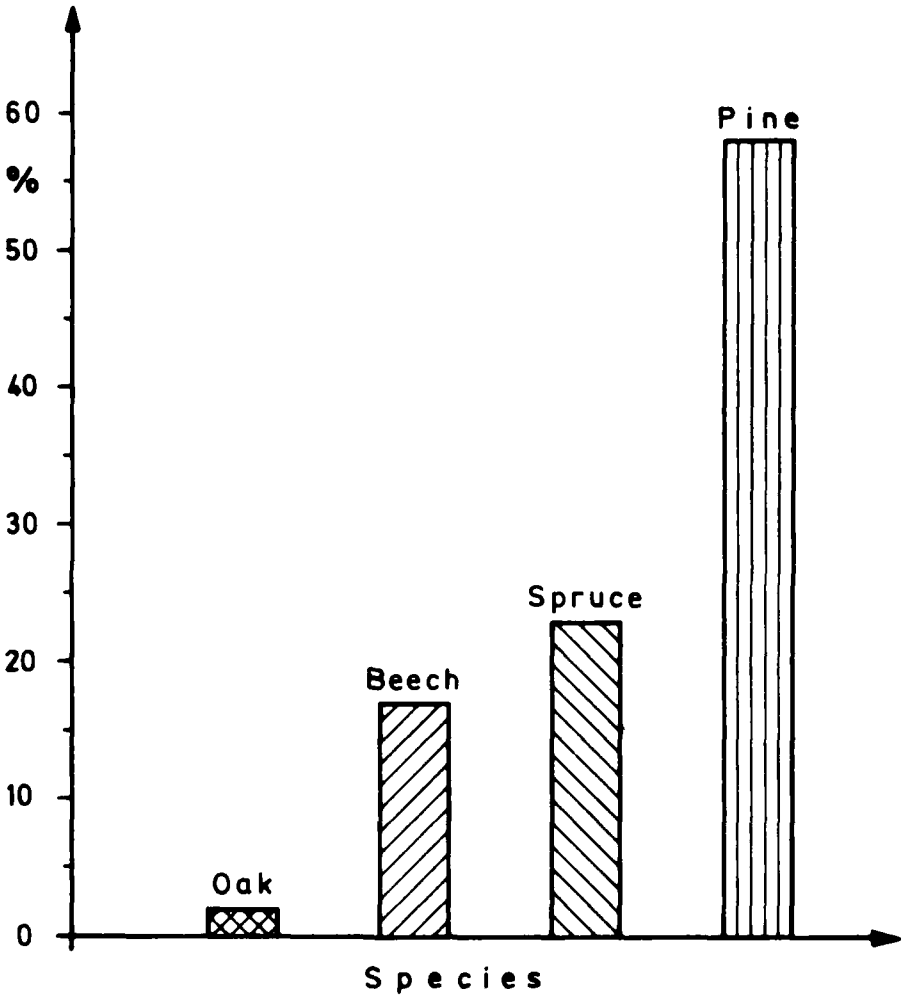


Fig. 11: Distribution of Species Within the Lauterbach Quad L 5322

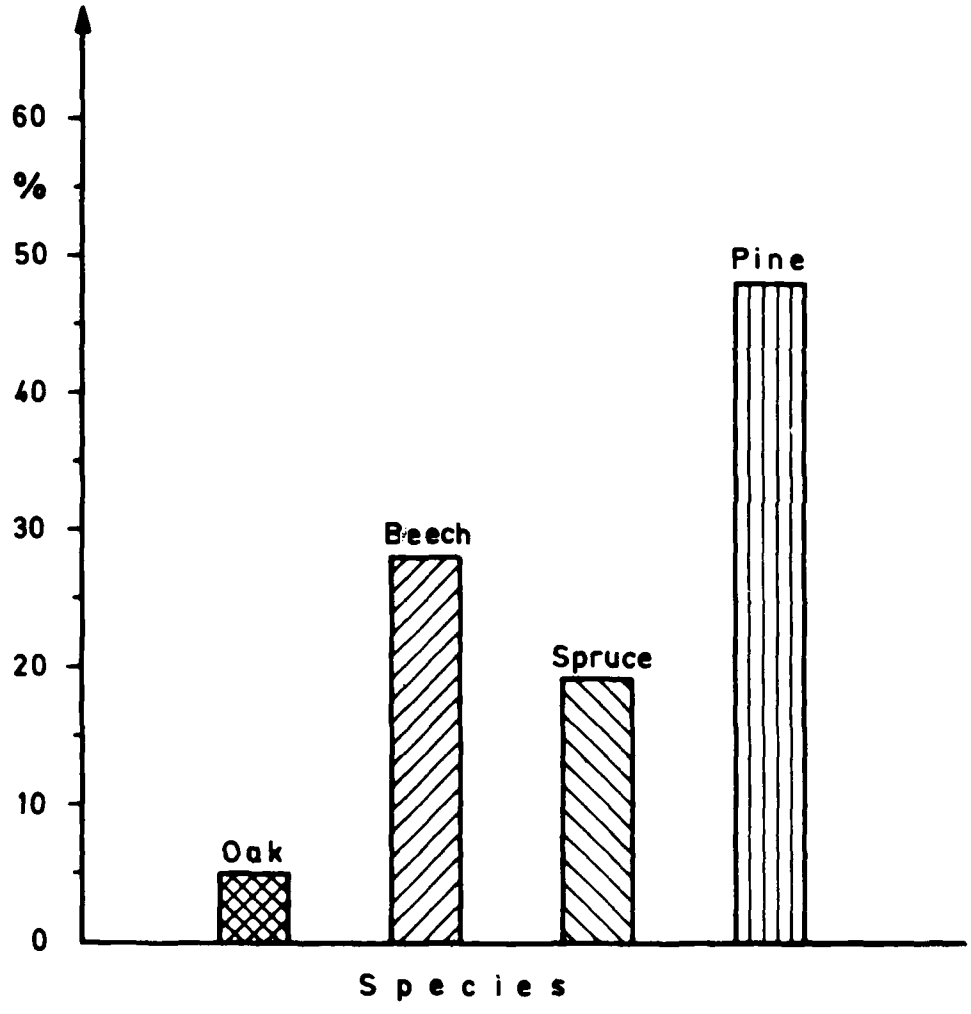


Fig. 12: Distribution of Species Within the Hünfeld Quad L 5324

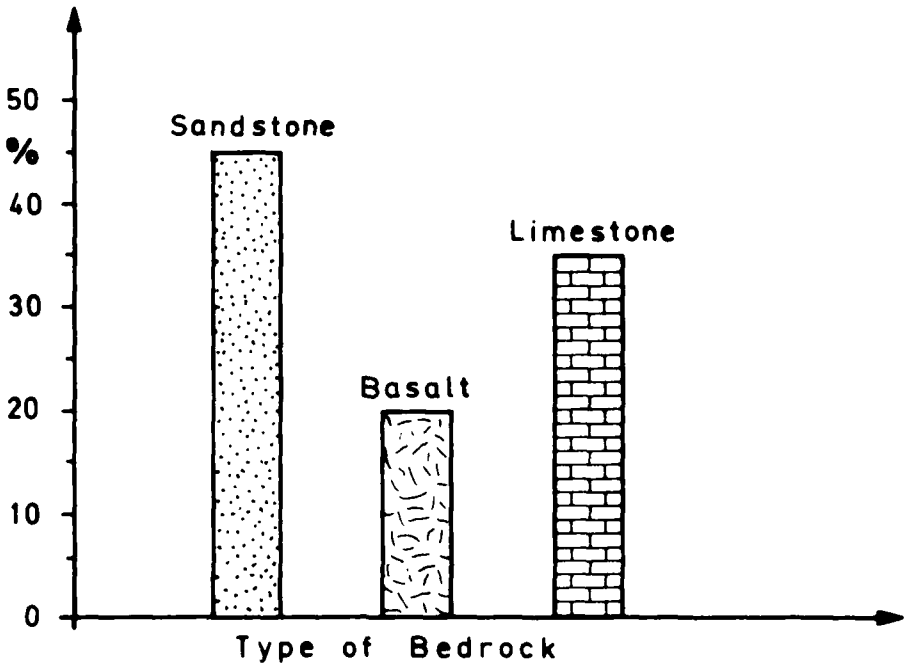


Fig. 13a: Distribution of Bedrock Within the Management Area of the Hünfeld Forestry Offcie

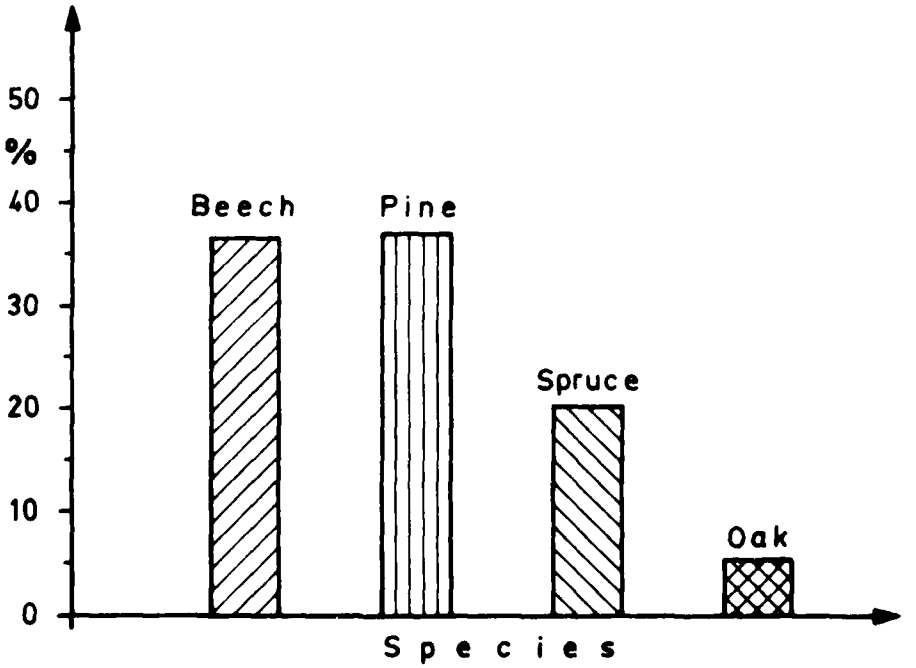


Fig. 13b: Distribution of Species Within the Management Area of the Hünfeld Forestry Office

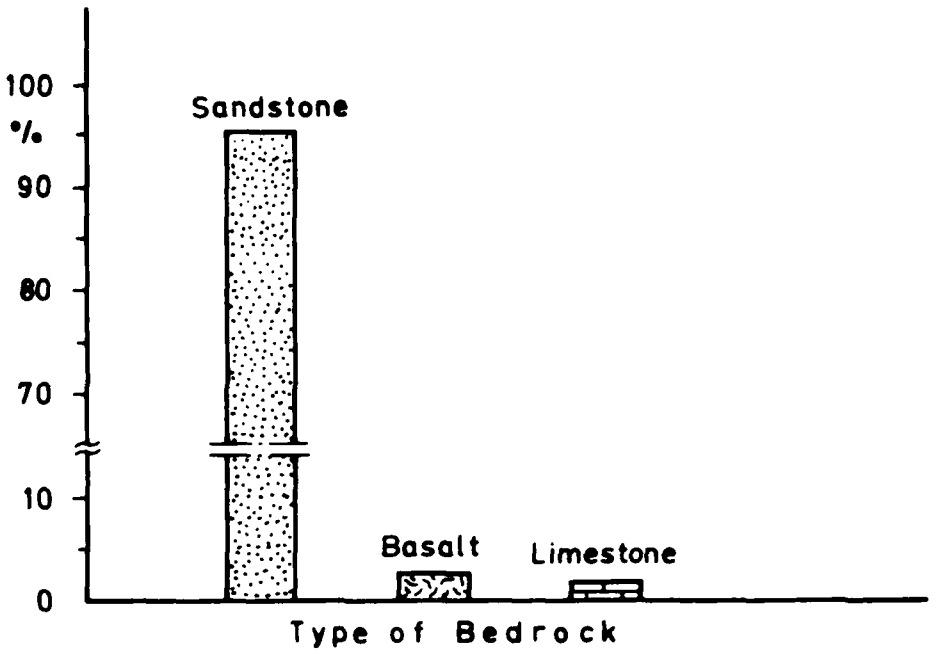


Fig. 14a: Distribution of Bedrock Within the Management Area of the Lauterbach Forestry Office

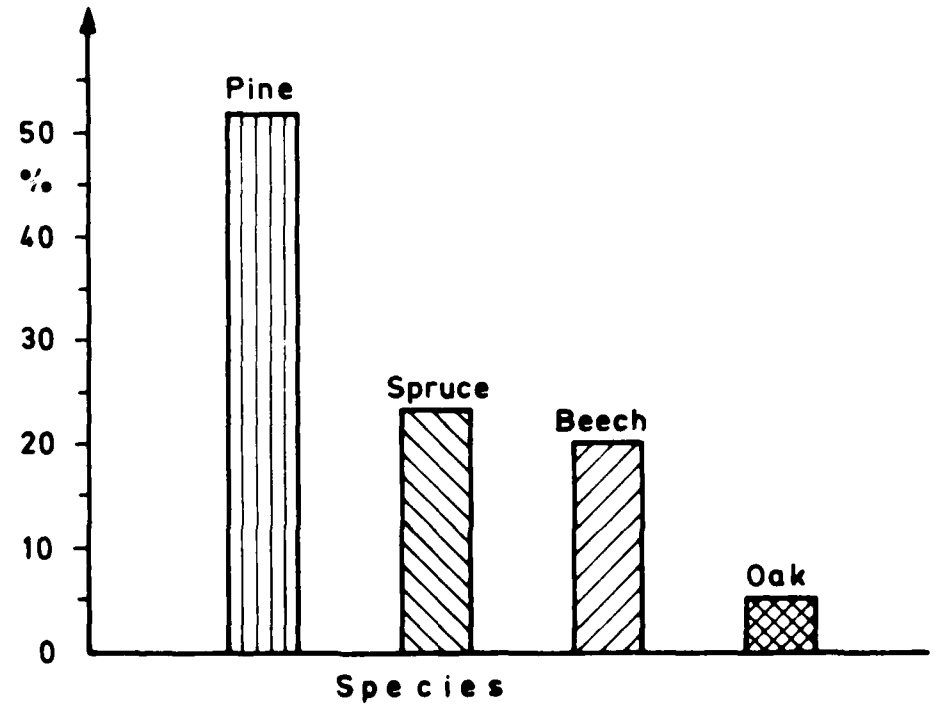


Fig. 14b: Distribution of Species Within the Management Area of the Lauterbach Forestry Office

FUNKTIONEN

Holzproduktion

GRENZWIRTSCHAFTSWALD

Schutzfunktionen

Wasserschutz
Schutz aus landespfleg. oder naturkundl. Gründen
Klima-, Immissions-, Sichtschutz
Bodenschutz, Straßenschutz

Erholung

Flächenanteil %	Stufe 1	Stufe 2	rechtlich ausgewiesen	Ausweisg. geplant	faktisch
10	x				x

Abt	Uabt	Fläche ha
23	A	

TW.

STANDORT

31 - 320 M. UEBER NN   UNTERE BU-MISCHW-ZONE   SCHWACH SUBKONTINENTAL   GRENZSTANDORT
50-5   MAESSIG GENEIGT   KIESELSCHIEFER   MAESSIG TROCKEN
SEHR FLACH- BIS FLACHGRUENDIG   50% STEINE   SANDIGER LEHM   MESOTROPH

Wuchsbezirk	Wuchszone	Klimafeuchte	Gel. Wasserhaush.	Trophie
62	33		42	

BESTAND

- EI-BAUMHOLZ
  BU-UNTERSTAND
  NICHT PFLEGEWUERDIG

PLANUNG

Best. Anteil %	Holzart	Alter	Mittelhöhe m	d	Bonität	Best. grad	Fläche ha	d	Fläche unter Schirm ha	d	Mischungsform	Schaftqualität	Vorrat Vfm	Hiebsmaßnahmen EN / VN / LT	10 x	Pflegeeinschlag Vfm/ha	mehr. Pflegefläche ha	d	Nutzung insges. Efm o R	Astung Stück	m	Schälschutz Stück	Art
100	EI	174	210		40	15	13					ASTIG	174	EN									
100	BU					01					[illegible]			EN									
							13						174										

Verjüngung

Hauptholzart	Holzart	Art der Begr.	Mischungsform	Fläche ha	d
EI	EI	NV		0	42

Sicherungsmaßnahmen

Dungung

Endnutzung: Eiche, Buche, Fichte, Kiefer — Efm o R

Vornutzung, Läuterung: Eiche, Buche, Fichte, Kiefer — Efm o R

Summe Wirtschaftseinheit

Fig. 15a: German Forestry Management Book Data Sheet (in German)

FUNCTION	Timber Production	Productive Forest			Compartment	Sub-Compartment	Area
	Protective Functions (climate, water, soil roads etc.)	Area	Step 1 | 2	Administrative Details			
	Recreation						

SITE FACTORS

Altitude, Topographical Position, Climate, Water Economy, Slope Conditions, Surface Soils, Bedrock, Nutrient Supply, etc.

STAND

Species
Understory Species
Care Details

Composition	Species	Age	Average Height	Locality Class	Degree of Stocking	Area	Area Under Canopy	Mixture Distribution	Stem Quality	Volume	PLANNING: Cutting Plan	Brushing Up	Barking Protection
											Tending Interventions, Nursing Areas Total Yield, etc	Item	Item

Thinning						
Dominant Species	Species	Reason for Thinning	Mixture Distribution	Area	Water Econ. Nutrient Supply	

Safeguarding

Fertilizing

Final Cutting — Oak, Beech, Spruce, Pine...

Intermediate Yield — Oak, Beech, Spruce, Pine...

Release Cutting — Oak, Beech, Spruce, Pine...

} Total of Management Unit

Fig. 15b: German Forestry Management Book Data Sheet (Translation)

Forest Office:						Dominant Species:					Inventory Date:				
Site No.	No. of Compartment	Total Area (ha)	Altitude Above Sea level (ft)	Slope (%)	Soil Type	Nutrient Supply	Water economy	Species	Area (ha)	Composition (%)	Age (years)	Height (ft)	Locality Class	Canopy Closure (%)	Remarks

Fig. 16: Site Conditions and Stand Information from Forestry Office Inventory Data

Slope Condtions

Condition	Slope (%)
flat	0 - 3
slightly inclined	>3 - 9
moderately inclined	>9 - 17
considerably inclined	>17 - 36
steep	>36 - 58
precipitous	>58 - 100
extremely precipitous	>100

Nutrient Supply

Condition	Class
eutrophic	1
mesotrophic	2
oligotrophic	3
dystrophic	4

Water Economy

Condition	Class
fresh	1
extremely fresh	2
moderately fresh	3
moderately dry	4
wet	5
alternating wet	6
extremely wet	7
percolating wet	8
dry	9

Canopy Closure*)

Condition	(%)
densely closed	>100
closed	>90 - 100
open	>75 - 90
extremely open	>50 - 70

Fig. 17: Forestry Classification of Site Conditions

*) Canopy closure was derived from degree of stocking given by forestry inventory data.

Forested Areas

Fig. 18: Location of Sites Within the Lauterbach Quad L 5322

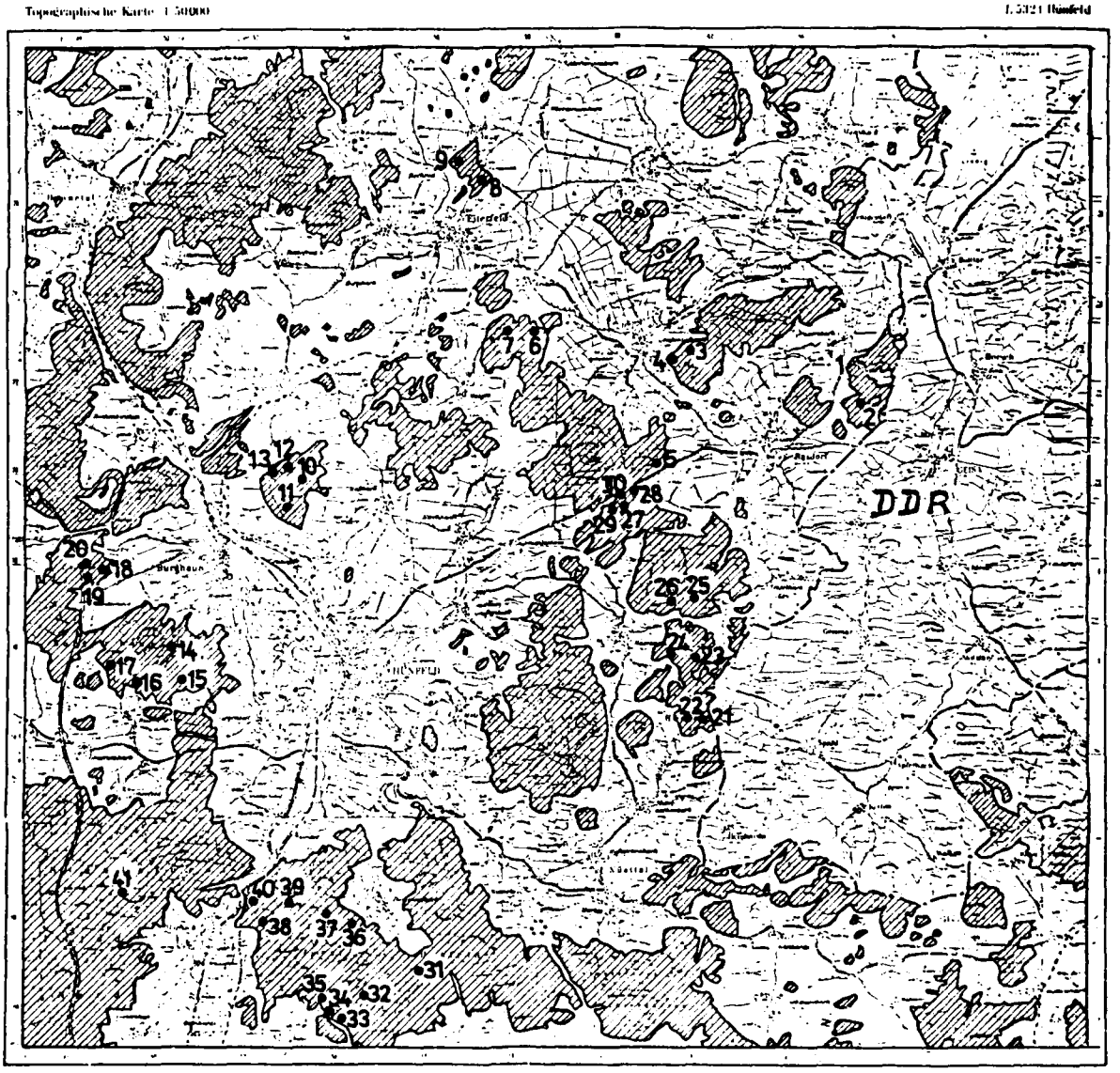


Fig. 19: Location of Sites Within the Hünfeld Quad L 5324

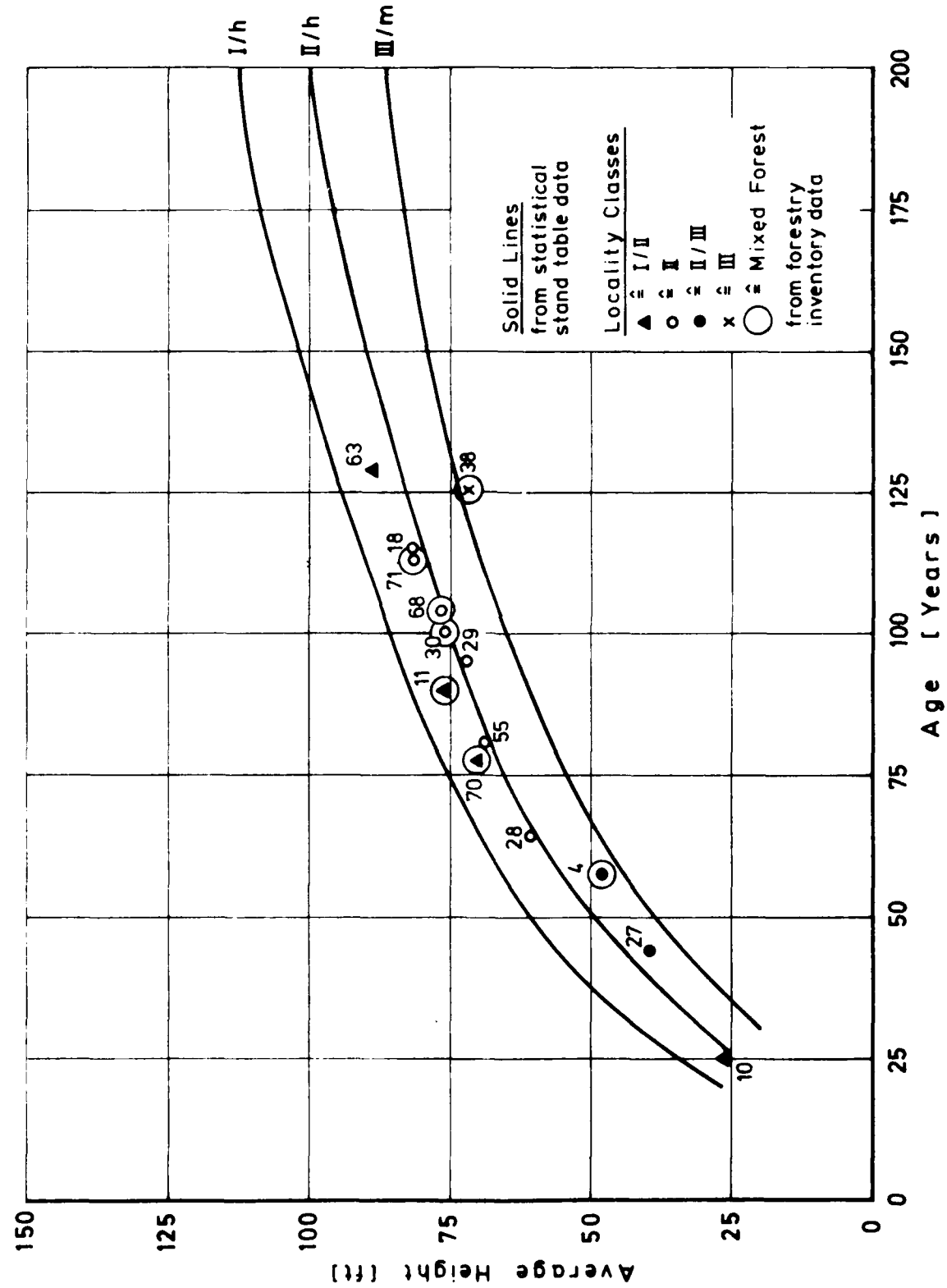


Fig. 20: Comparison of Inventory Data to Average Height-Age Stand Table Data for Oak

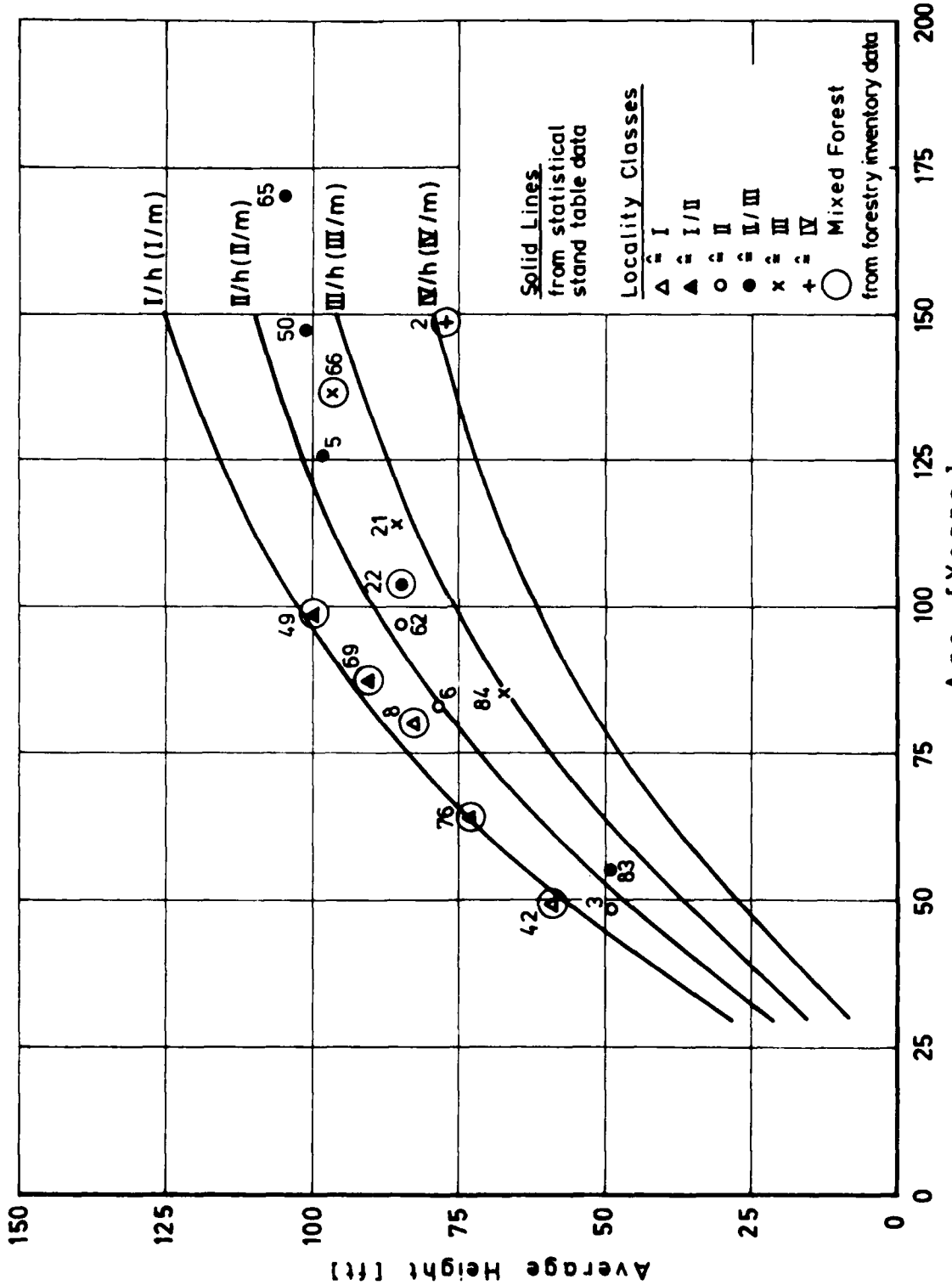


Fig. 21: Comparison of Inventory Data to Average Height-Age Stand Table Data for Beech

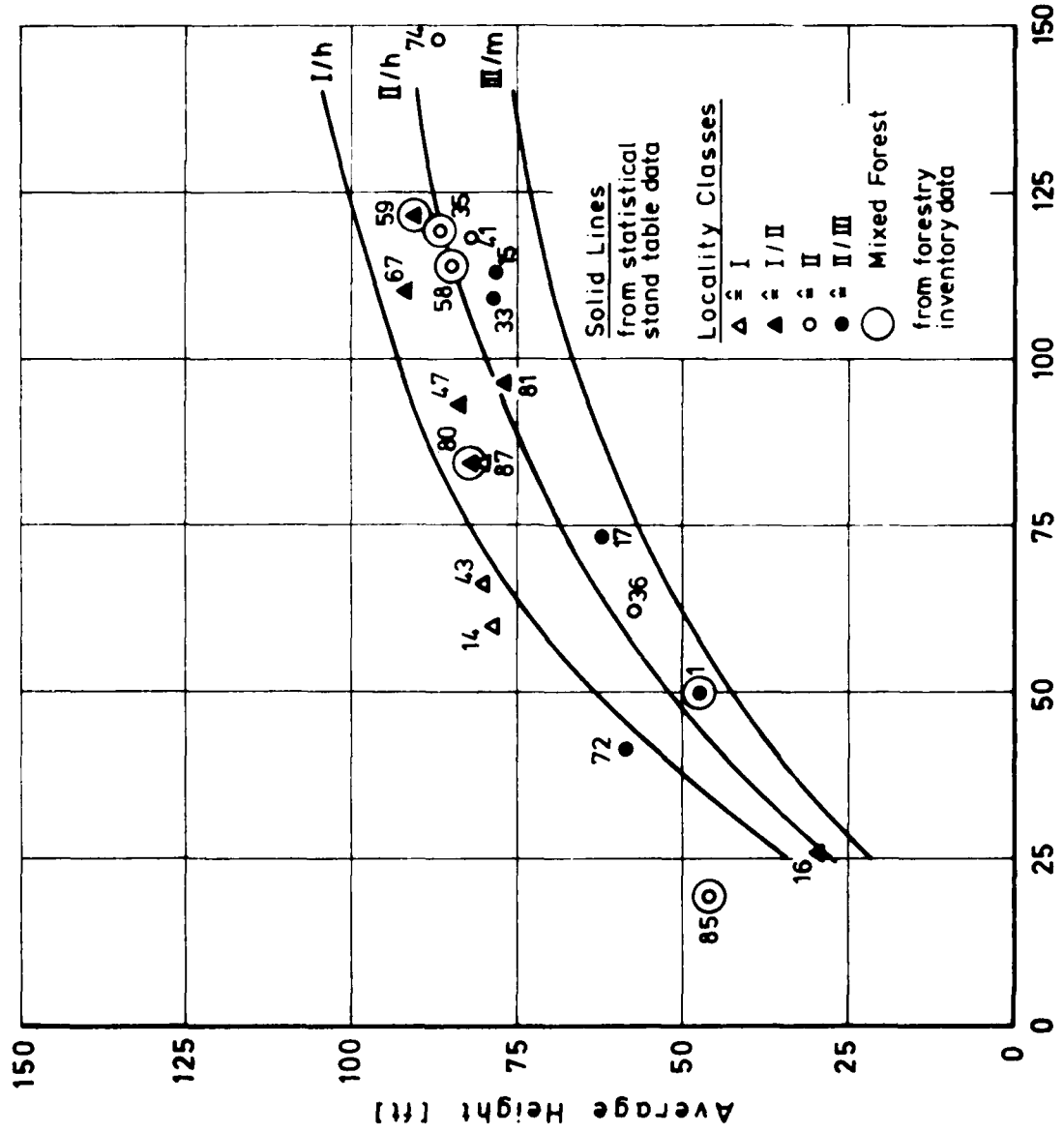


Fig. 22: Comparison of Inventory Data to Average Height-Age Stand Table Data for Pine

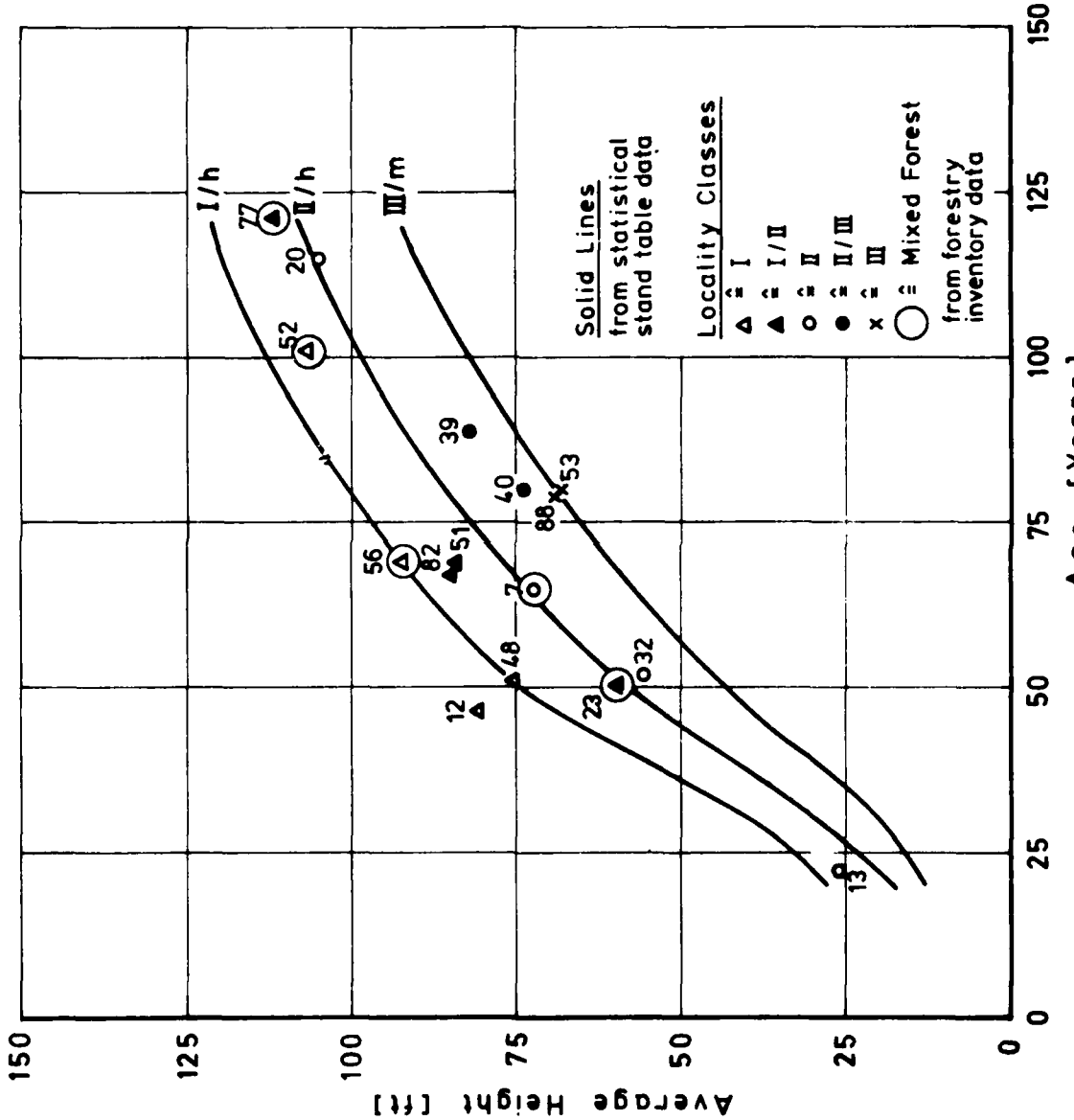


Fig. 23: Comparison of Inventory Data to Average Height-Age Stand Table Data for Spruce

Site No.	UTM-Coordinates →	UTM-Coordinates ↑
86	5288	6203
87	5285	6202
68	5351	6203
20	5479	6161
16	5497	6134
17	5492	6135
14	5502	6147
12	5529	6186
10	5537	6187
5	5605	6184
3	5618	6213
4	5613	6211
31	5564	6077

Fig. 24: UTM-Coordinates of the Field Sites Visited

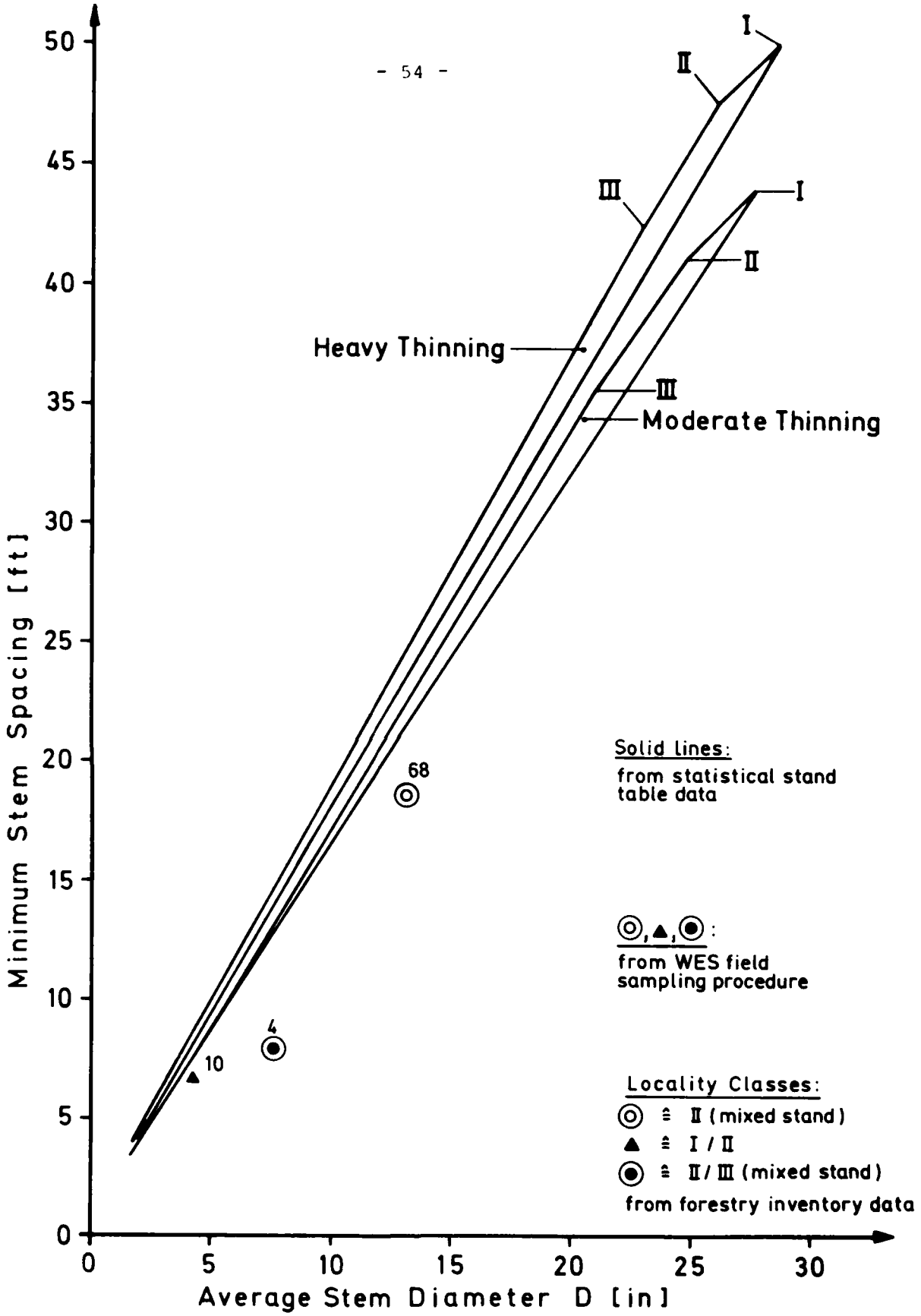


Fig. 25: Comparison of Inventory Data and Field Data to Minimum Stem Spacing-Average Stem Diameter Stand Table Curves for Oak

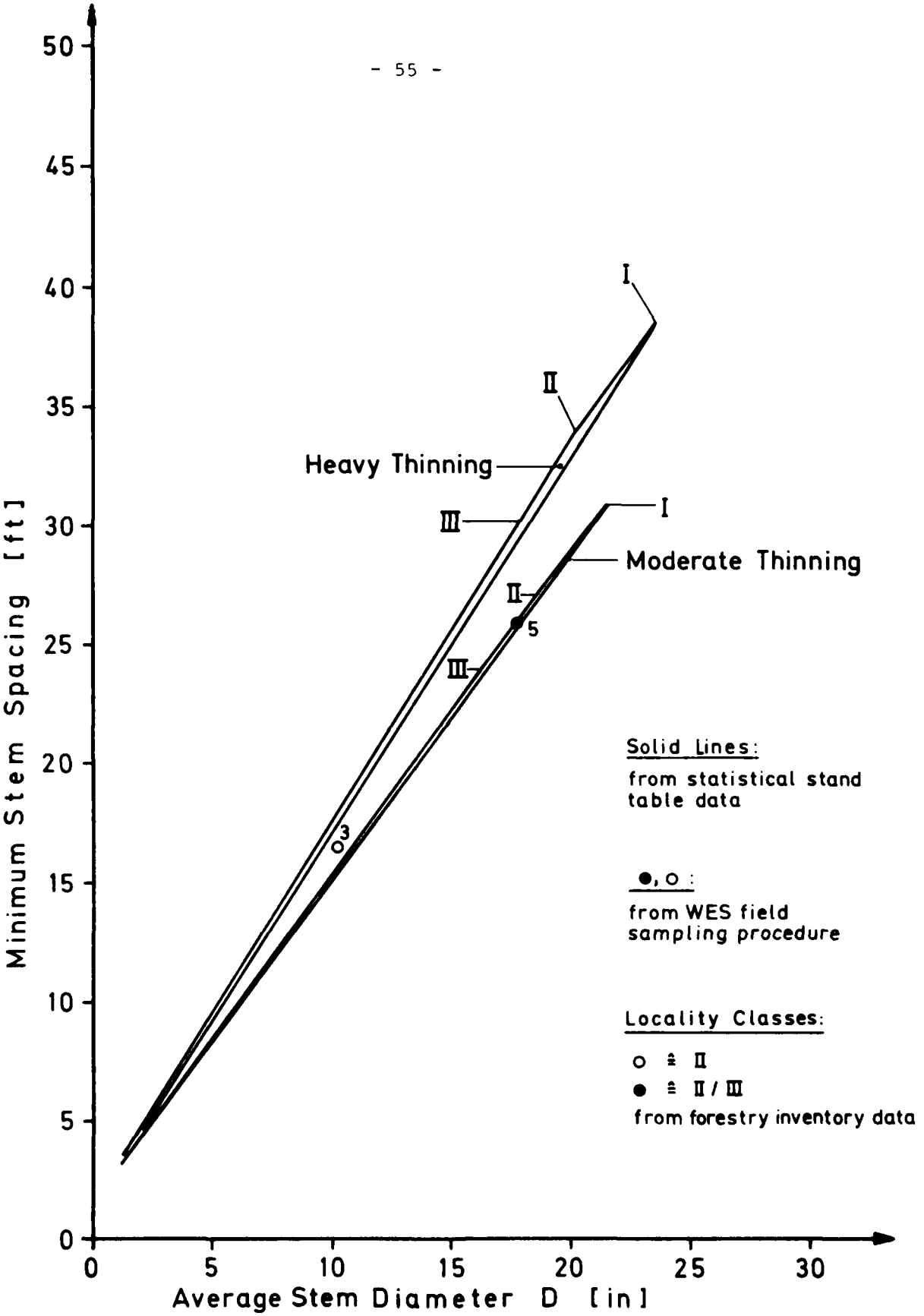


Fig. 26: Comparison of Inventory Data and Field Data to Minimum Stem Spacing-Average Stem Diameter Stand Table Curves for Beech

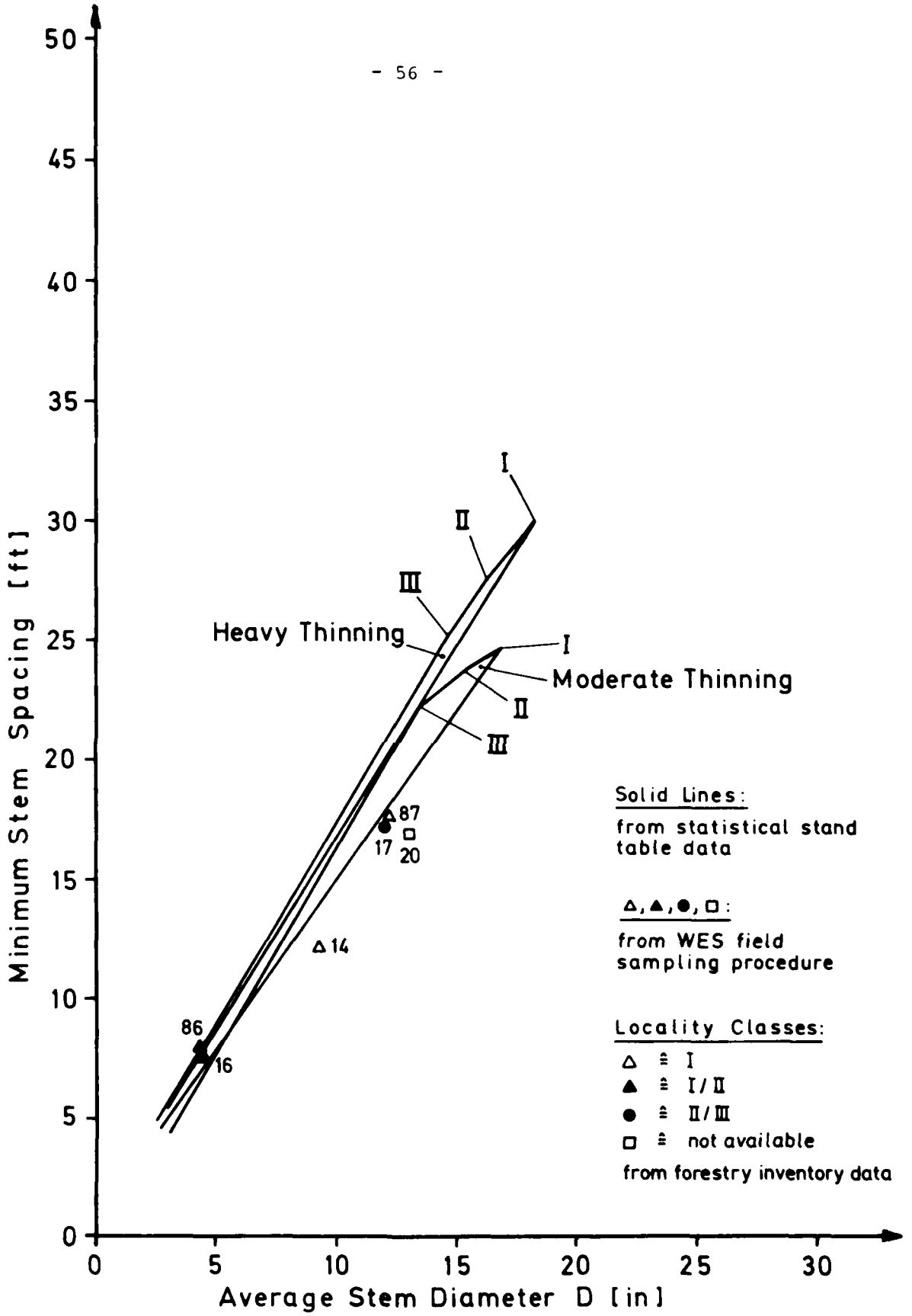


Fig. 27: Comparison of Inventory Data and Field Data to Minimum Stem Spacing-Average Stem Diameter Stand Table Curves for Pine

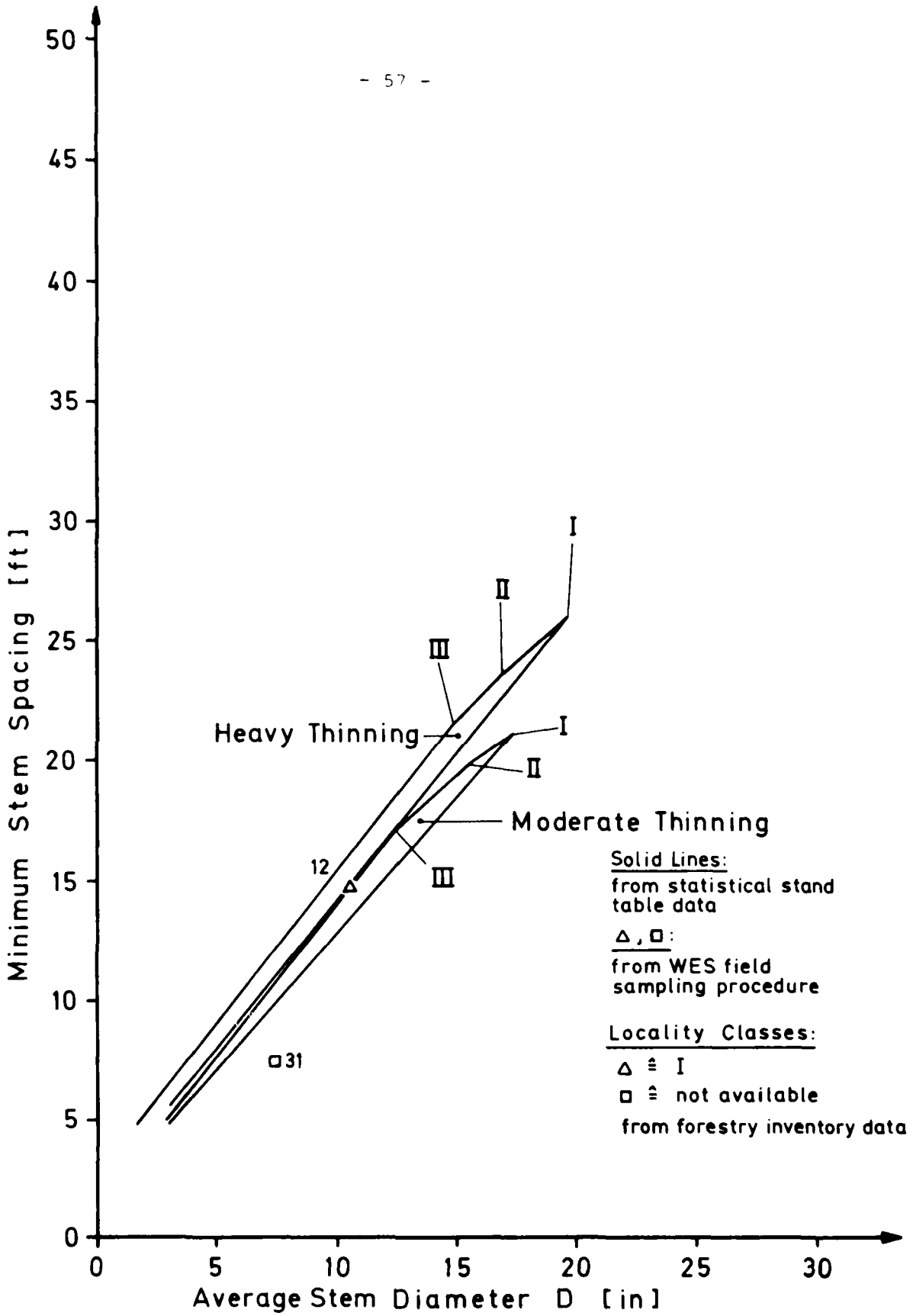


Fig. 28: Comparison of Inventory Data and Field Data to Minimum Stem Spacing-Average Stem Diameter Stand Table Curves for Spruce

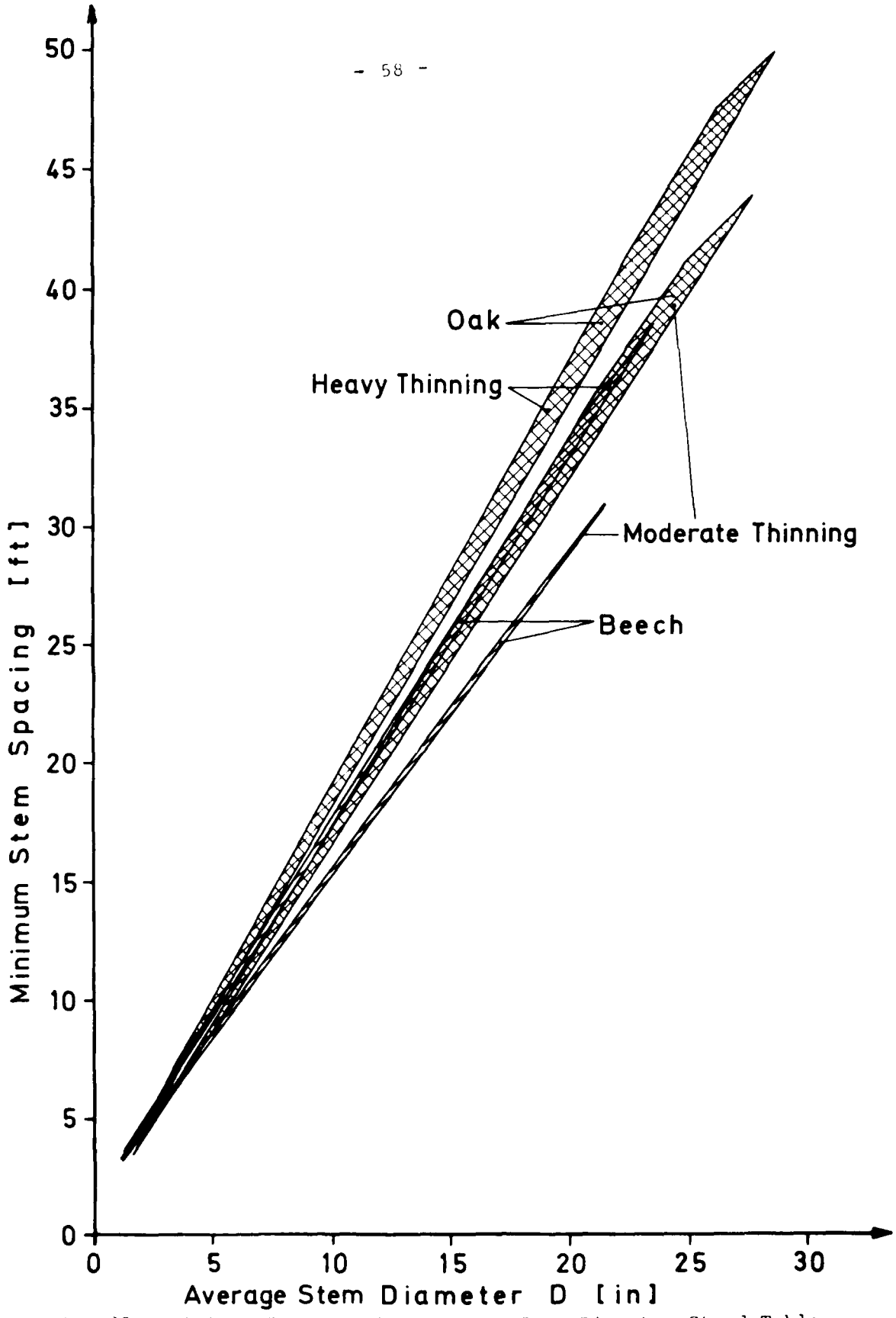


Fig. 29: Minimum Stem Spacing-Average Stem Diameter Stand Table Curves for Deciduous Species

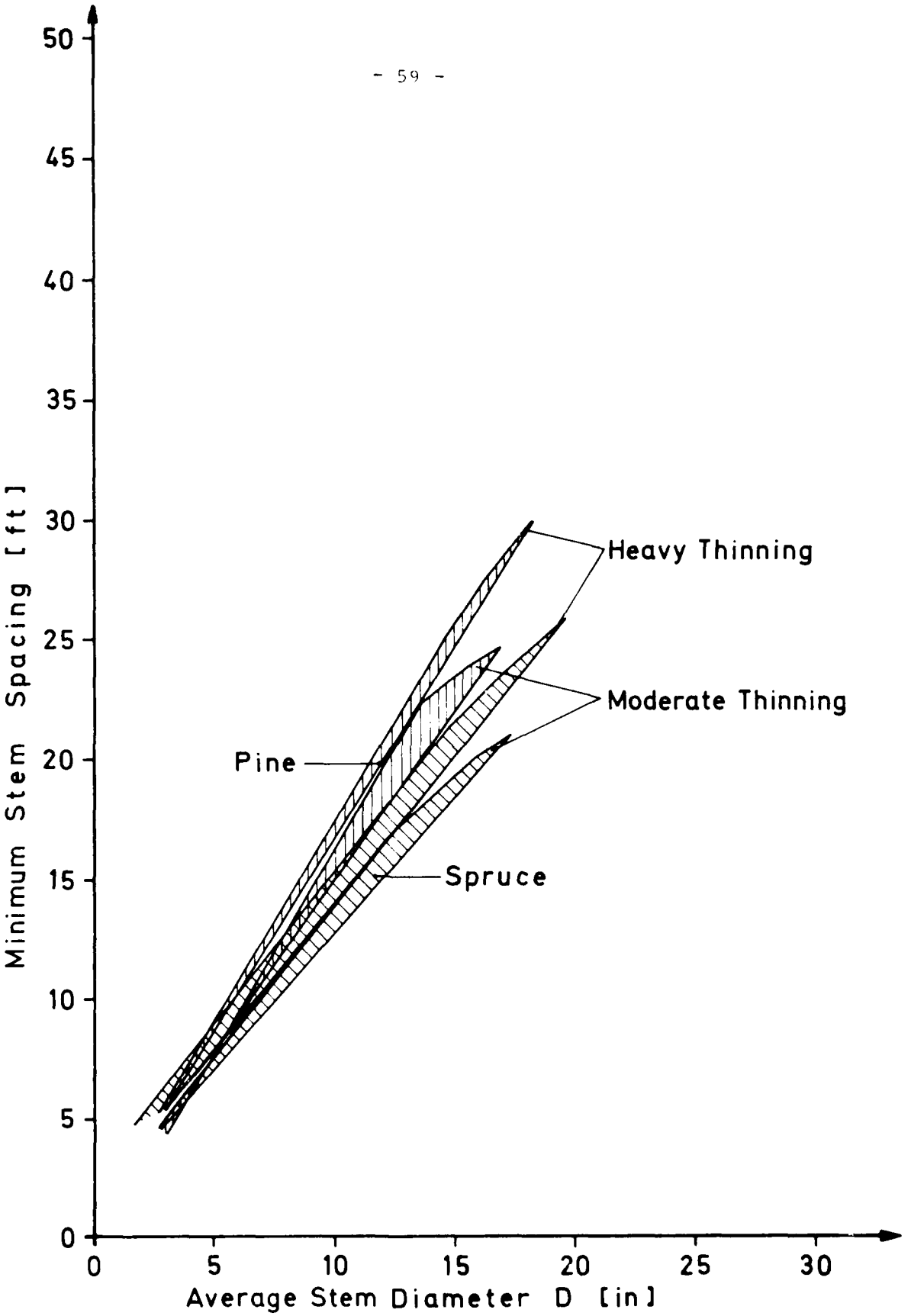


Fig. 30: Minimum Stem Spacing-Average Stem Diameter Stand Table Curves for Coniferous Species

No. of Compartment	Forestry Office	Dominant Species	Current Forestry Inventory Data +)			Measured Field Data ++)			Interpolated Data +++) Using					
									DA and H		H and SS_M		DA and SS_M	
			Locality Class	Age (years)	Height (ft)	Minimum Stem Spacing SS_M (ft)	Average Stem Diameter DA (inch)	Height H (ft)	Local. Class	Age (years)	Local. Class	Age (years)	Local. Class	Age (years)
68	Grebenau	oak	II	104	77.0	18.0	13.0	75	II/h	97	I/h	68	II/m	94
86	"	pine	I/II	22	-	8.0	4.3	45	I/m	27	I/m	30	I/h	25
87	"	pine	I	84	80.3	17.4	12.4	90	I/h	82	I/m	85	I/m	81
3	Burghaun	beech	II	49	49.2	16.4	10.3	54	I/h	59	I/h	56	I/h	72
4	"	oak	II/III	58	48.5	7.7	7.5	40	III/h	58	III/m	49	I/m	42
5	"	beech	II/III	125	98.4	25.8	17.8	105	II/h	130	I/h	102	I/m	123
10	"	oak	I/II	25	26.2	6.6	4.3	45	I/m	31	I/m	28	I/m	29
12	"	spruce	< I	46	80.3	14.6	10.6	74	III/h	79	III/h	76	I/h	60
14	"	pine	I	60	78.7	12.1	9.3	72	I/h	54	I/m	53	I/m	52
16	"	"	I/II	26	29.5	7.5	4.7	36	III/m	38	III/h	35	II/m	32
17	"	"	II/III	73	62.3	16.9	12.1	78	II/h	90	I/h	63	I/m	78
20	"	"	II	115	104.9	16.7	13.0	90	I/m	89	I/m	83	I/m	81
31	Hünfeld	spruce	-	19	-	7.3	7.4	75	I/m	34	I/m	27	I/m	24

+) Data collected in 1975 (site 31 in 1962)

++) Taken in 1979

+++) Ages were reduced to 1975 (and 1962 for site 31)

Fig. 31: Summary of Current Inventory Data, Measured Data and Interpolated Data for Selected Sites

L 5322

Limestone Bedrock Area

(see photo 2)

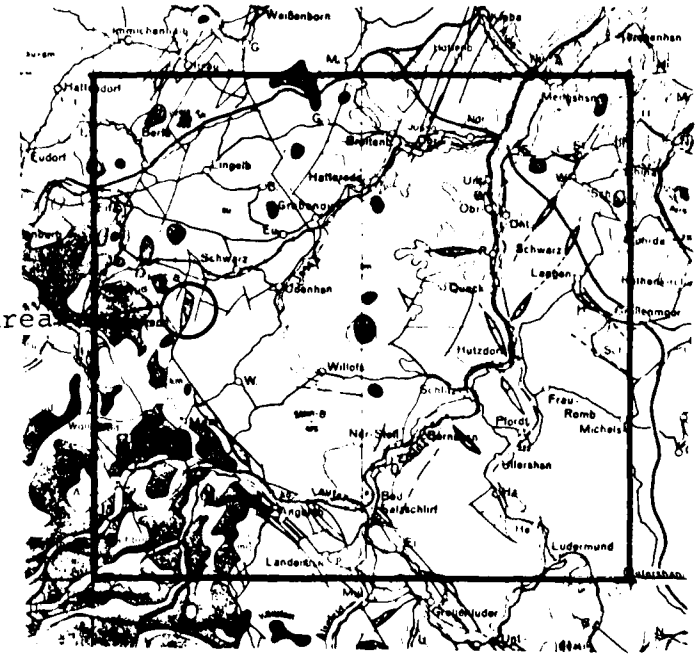


Fig. 32: Limestone Bedrock Area Investigated Within the Lauterbach Quad L 5322

Inventory Data (1 January 1975)													Prediction by Air Photo Evaluation +)			
No. of Compartment	Total Area (ha)	Altitude Above Sea Level (ft)	Slope (%)	Soil Type	Nutrient Supply	Water economy	Species	Area (ha)	Age (years)	Locality Class	Composition (%)	Height (ft)	Canopy Closure (%)	Species	Composition (%)	Height (ft)	Canopy Closure (%)
123a	4.4	1147.5 - 1213.1	0-3 9-17	SM	2	1	Pine	2.9	24	I	68		>100	Pine	80	49	>90-100
							Spruce	1.5	24	I	34		>100	Spruce	20	49	>90-100
123b		1147.5 - 1213.1	0-3 9-17	SM	2	1	Pine	1	34	I/II	100		>90-100	Pine	100	72	>100
							Beech			IV							Underst.
119	2.3	1245.9 - 1278.7	0-9	SM	3	1	Pine	1.9	27.5	II	82		>100	Pine	90	88.5	>90-100
							Spruce	0.4	29	I/II	18		>100	Spruce	10	88.5	>90-100
121	7.2	1245.9	0	SM	2	6	Pine	7.0	131	I/II	93	95	>90-100	Pine	80	98	>90-100
							Spruce	0.2	100	II	7	97	>90-100				
							Oak							Oak	10	98	
							Beech							Beech	10	98	
117	7.0	1245.9 - 1278.7	0-9	SM	2	1	Beech	5.2	90	II	100	84	>75-90	Beech	90	92	>90-100
							Pine	1.8	136	II	100	92					
							Oak							Oak	10	92	
127	7.4	1278.7 - 1344.3	0	SM	3	6	Pine	6.9	131	I/II	93	97	>90-100	Pine	90	92	>100
							Spruce	0.4	110	II	5	100	>90-100				
							Beech	0.1	110		2	-					
							Oak							Oak	10	92	

+) Photos Dated 1973

Fig. 33: Prediction of Site Characteristics by Air Photo Evaluation for 6 Compartments Within the Management Area of the Grebenau Forestry Office

Inventory Data (1 January 1975)														Prediction by Air Photo Evaluation +)			
No. of Compartment	Total Area (ha)	Altitude Above Sea Level (ft)	Slope (%)	Soil Type	Nutrient Supply	Water economy	Species	Area (ha)	Age (years)	Locality Class	Composition (%)	Height (ft)	Canopy Closure (%)	Species	Composition (%)	Height (ft)	Canopy Closure (%)
23a	19.7	1311.5 - 1491.8	9-17		1	1	Beech	13.6	62	II	70	61	>100	Beech	100	59	>100
							Spruce	6.1	62	II	30	53	>100				
23b	3.0	1278.7 - 1344.3	9-17		1	3	Beech	1.8	94	III	60	72	>75-90	Beech	90	92	>90-100
							Oak	1.5	94	IV	40	61	>75-90				
														Spruce	10		
24a	12.7	1213.1 - 1409.8	3-17		1	2	Beech	12.0	137	II/III	95	102	> 50-70	Beech	100	98	>75-90
							Oak	0.7	137	II	5	121	> 50-70				
26	16.0	1311.5 - 1475.4	3-9 17-36		1	1	Beech	14.8	55	I/II	95	62	> 100	Beech	90	49	> 100
							Pine	1.2	44	I	5	56	> 100				
														Spruce	10	49	

+) Photos Dated 1973

Fig. 34: Prediction of Site Characteristics by Air Photo Evaluation for 4 Compartments Within the Management Area of the Burghaun Forestry Office

Table 1.1: Statistical Stand Table Data for Oak: Average Height (ft)

Age (years) \ Locality Class/ Method of Thinning	I/h*)	I/m*)	II/h*)	II/m*)	III/h*)	III/m*)	IV/m*)
20	26.9	25.6	-	-	-	-	-
25	34.8	32.8	25.6	23.6	-	-	-
30	42.3	41.3	30.8	29.5	19.7	18.7	-
35	47.6	46.3	36.1	35.1	24.9	23.3	-
40	52.8	51.2	41.0	39.4	30.2	28.9	17.1
45	57.1	56.1	45.6	43.6	34.4	33.3	20.7
50	61.0	60.4	49.7	47.7	38.7	37.7	24.3
55	64.6	63.4	53.5	51.8	42.7	41.3	27.6
60	68.2	67.2	56.8	55.4	45.9	44.9	30.8
65	71.2	70-2	59.7	58.7	49.2	48.2	34.1
70	74.1	73.2	62.7	61.7	51.5	50.8	37.4
75	76.1	75.8	65.3	64.3	54.1	53.5	40.0
80	78.1	78.1	67.6	66.6	56.4	55.4	42.6
85	80.0	80.4	69.5	68.9	58.7	57.4	44.4
90	82.0	82.0	71.5	70.9	60.7	59.4	47.2
95	84.0	83.7	73.5	72.8	62.7	61.7	49.5
100	85.6	85.3	75.5	74.8	64.6	63.6	51.5
105	87.6	86.9	77.4	76.4	66.3	65.6	53.5
110	89.2	88.9	78.7	78.1	68.2	67.6	55.4
115	91.2	90.5	80.4	79.7	69.9	69.5	57.1
120	92.8	92.2	82.0	81.3	71.5	71.5	58.7
125	94.5	93.8	83.7	83.0	73.2	73.2	60.4
130	95.8	95.5	85.0	84.6	74.5	74.4	61.6
135	97.1	97.1	86.3	86.2	75.8	75.8	62.4
140	98.7	98.4	87.9	87.9	76.8	77.1	64.3
145	100.1	99.7	89.2	89.6	77.8	78.4	65.0
150	101.7	101.4	90.6	90.9	78.7	79.1	65.6
155	103.3	102.7	91.9	91.8	79.7	79.7	65.9
160	104.7	104.0	93.2	92.8	80.7	80.4	66.3
165	103.6	105.3	94.2	93.8	71.7	81.0	-
170	107.6	106.9	95.1	94.8	82.3	81.7	-
175	108.9	108.3	96.1	95.8	83.0	82.3	-
180	109.9	109.6	97.1	96.5	83.7	83.0	-
185	110.9	110.2	97.8	97.1	84.3	83.7	-
190	111.5	110.9	98.4	97.8	85.0	84.0	-
195	112.2	111.5	99.1	98.4	85.6	84.3	-
200	112.9	112.2	99.7	99.1	86.0	85.0	-

*) h ≙ heavy thinning
m ≙ moderate thinning

Table 1.2: Statistical Stand Table Data for Oak: Average Stem Diameter (in)

Age (years) \ Locality Class/ Method of Thinning	I/h	I/m	II/h	II/m	III/h	III/m	IV/m
20	2.5	1.7	-	-	-	-	-
25	3.1	2.6	2.3	1.8	-	-	-
30	3.8	3.5	3.0	2.8	2.0	1.5	-
35	4.5	4.2	3.7	3.5	2.5	1.9	-
40	5.3	4.9	4.4	4.1	3.1	2.4	1.5
45	6.0	5.6	5.1	4.8	3.8	3.0	1.9
50	6.7	6.3	5.8	5.4	4.5	3.6	2.3
55	7.4	7.0	6.5	6.0	5.2	4.3	2.7
60	8.2	7.7	7.1	6.7	5.9	5.0	3.1
65	8.9	8.4	7.8	7.4	6.5	5.6	3.5
70	9.6	9.1	8.5	8.1	7.3	6.2	4.0
75	10.4	9.8	9.2	8.3	7.9	6.8	4.5
80	11.1	10.6	9.9	9.4	8.6	7.3	5.0
85	11.9	11.3	10.6	10.1	9.3	7.9	5.4
90	12.6	12.0	11.3	10.7	10.0	8.4	5.9
95	13.3	12.7	11.9	11.4	10.6	8.9	6.3
100	14.1	13.4	12.6	12.1	11.3	9.4	6.7
105	14.8	14.1	13.3	12.8	12.0	9.9	7.0
110	15.5	14.9	14.0	13.4	12.6	10.4	7.4
115	16.3	15.6	14.7	14.1	13.2	10.9	7.8
120	17.0	16.3	15.4	14.8	13.9	11.5	8.2
125	17.7	17.0	16.1	15.4	14.5	12.0	8.6
130	18.5	17.7	16.8	16.1	15.0	12.6	9.0
135	19.2	18.4	17.4	16.9	15.6	13.2	9.4
140	20.0	19.2	18.1	17.7	16.2	13.8	9.8
145	20.7	19.9	18.8	18.2	16.8	14.4	10.2
150	21.4	20.6	19.5	18.8	17.4	15.9	10.6
155	22.1	21.3	20.2	19.4	18.0	15.6	10.9
160	22.8	22.0	20.9	20.0	18.5	16.2	11.2
165	23.6	22.7	21.5	20.7	19.1	16.8	-
170	24.4	23.6	22.2	21.3	19.7	17.5	-
175	25.1	24.1	22.8	21.9	20.3	18.1	-
180	25.9	24.9	23.5	22.5	20.8	18.7	-
185	26.5	25.6	24.1	23.1	21.4	19.3	-
190	27.3	26.3	24.8	23.7	22.0	19.9	-
195	28.0	26.9	25.4	24.3	22.5	20.5	-
200	28.7	27.6	26.1	24.9	23.1	21.1	-

Table 1.3: Statistical Stand Table Data for Oak:
Minimum Stem Spacing (ft)

Age (years) \ Locality Class/ Method of Thinning	I/h	I/m	II/h	II/m	III/h	III/m	IV/m
20	5.3	3.5	-	-	-	-	-
25	6.4	5.1	4.9	3.8	-	-	-
30	7.5	6.7	6.2	5.6	4.2	3.2	-
35	8.7	7.9	7.5	6.8	5.3	3.4	-
40	10.1	9.1	8.8	7.8	6.5	4.6	3.1
45	11.4	10.2	10.1	8.9	7.8	5.8	3.8
50	12.7	11.3	11.3	10.0	9.1	6.8	4.5
55	14.0	12.3	12.5	10.9	10.0	8.1	5.2
60	15.2	13.2	13.8	11.9	11.6	9.3	5.9
65	16.5	14.3	15.0	12.9	12.9	10.2	6.7
70	17.8	15.4	16.2	14.1	14.3	11.2	7.5
75	19.1	16.5	17.5	15.2	15.5	12.1	8.3
80	20.4	17.6	18.7	16.2	16.9	12.9	9.1
85	21.6	18.7	19.9	17.2	18.0	13.7	9.9
90	22.9	19.9	21.1	18.2	19.2	14.8	16.5
95	24.2	21.0	22.3	19.3	20.5	15.3	11.2
100	25.4	22.1	23.5	20.4	21.9	16.2	11.9
105	26.6	23.3	24.8	21.5	23.1	17.0	12.5
110	28.0	24.5	26.0	22.6	24.3	17.8	13.1
115	29.2	25.7	27.2	23.7	25.4	18.6	13.8
120	30.5	26.8	28.5	24.7	26.6	19.6	14.5
125	31.7	27.9	29.7	25.8	27.8	20.5	15.1
130	32.9	29.1	30.9	27.1	28.9	21.5	15.7
135	34.2	30.2	32.2	28.2	30.0	22.5	16.4
140	35.4	31.2	33.3	29.3	31.0	23.5	17.0
145	36.6	32.4	34.6	30.5	32.2	24.5	17.7
150	37.9	33.5	35.9	31.5	33.3	25.5	18.3
155	39.5	34.0	37.1	32.4	34.4	26.5	19.0
160	40.5	35.7	38.3	33.5	35.5	27.4	19.6
165	41.7	36.7	39.5	34.4	36.6	28.5	-
170	43.1	37.4	40.7	35.4	37.7	29.5	-
175	44.3	38.9	42.0	36.4	38.7	30.6	-
180	45.7	40.0	43.1	37.3	39.8	31.6	-
185	46.7	41.0	44.3	38.3	40.7	32.7	-
190	47.9	42.0	45.3	39.1	41.7	33.6	-
195	49.1	43.1	46.4	40.0	43.0	34.6	-
200	50.0	44.0	47.5	41.0	44.0	35.5	-

Table 2.1: Statistical Stand Table Data for Beech: Average Height (ft)

Age (years) \ Locality Class/ Method of Thinning	I/h	I/m	II/h	II/m	III/h	III/m	IV/h	IV/m
30	28.5	28.5	22.0	22.0	15.4	15.4	8.9	8.9
35	35.8	35.8	27.9	27.9	20.0	20.0	12.1	12.1
40	43.3	43.3	34.4	34.4	25.6	35.6	16.7	26.7
45	50.9	50.9	41.3	41.3	31.8	31.8	22.3	22.3
50	57.7	57.7	47.6	47.6	37.4	37.4	27.2	27.2
55	64.3	64.3	53.5	53.5	42.7	42.7	31.8	31.8
60	69.9	69.9	58.7	58.7	47.6	47.6	36.4	36.4
65	74.8	74.8	63.6	63.6	52.2	52.2	41.0	41.0
70	79.9	79.9	67.9	67.9	56.4	56.4	44.9	44.9
75	84.0	84.0	72.2	72.2	60.4	60.4	48.6	48.6
80	88.3	88.3	76.1	76.1	64.0	64.0	51.8	51.8
85	92.2	92.2	79.7	79.7	67.3	67.3	54.8	54.8
90	96.1	96.1	83.3	83.3	70.5	70.5	57.7	57.7
95	99.7	99.7	86.6	86.6	73.5	73.5	60.4	60.4
100	103.0	103.0	89.9	89.9	76.4	76.4	63.0	63.0
105	106.0	106.0	92.5	92.5	79.1	79.1	65.6	65.6
110	108.9	108.9	95.1	95.1	81.7	81.7	67.9	67.9
115	111.5	111.5	97.8	97.8	84.0	84.0	70.2	70.2
120	114.2	114.2	100.1	100.1	86.0	86.0	71.9	71.9
125	116.5	116.5	102.0	102.0	87.9	87.9	73.5	73.5
130	118.4	118.4	104.0	104.0	89.6	89.6	75.1	75.1
135	120.4	120.4	105.6	105.6	91.2	91.2	76.4	76.4
140	122.4	122.4	107.3	107.3	92.5	92.5	77.8	77.8
145	124.0	124.0	108.9	108.9	93.8	93.8	79.1	79.1
150	125.7	125.7	110.6	110.6	95.1	95.1	80.1	80.1

Table 2.2: Statistical Stand Table Data for Beech: Average Stem Diameter (in)

Age (years) \ Locality Class/ Method of Thinning	I/h	I/m	II/h	II/m	III/h	III/m	IV/h	IV/m
30	2.1	2.1	1.7	1.7	1.2	1.2	-	-
35	3.0	2.8	2.3	2.3	1.7	1.7	-	-
40	3.8	3.6	3.1	3.1	2.2	2.2	1.7	1.7
45	4.7	4.3	3.8	3.7	2.9	2.8	2.1	2.1
50	5.6	5.1	4.6	4.4	3.6	3.4	2.7	2.6
55	6.5	5.8	5.4	5.1	4.3	4.0	3.2	3.1
60	7.3	6.6	6.1	5.7	4.9	4.6	3.8	3.6
65	8.1	7.4	6.9	6.5	5.6	5.3	4.4	4.2
70	9.0	8.2	7.6	7.2	6.3	5.9	5.0	4.7
75	9.8	9.1	8.4	8.0	6.9	6.6	5.6	5.3
80	10.6	9.9	9.2	8.7	7.6	7.2	6.2	5.9
85	11.5	10.7	10.0	9.4	8.3	8.0	6.8	6.5
90	12.3	11.6	10.7	10.1	8.9	8.6	7.4	7.1
95	13.2	12.4	11.5	10.8	9.6	9.3	8.0	7.7
100	14.1	13.2	12.3	11.5	10.3	9.9	8.6	8.3
105	14.9	14.1	13.0	12.2	11.0	10.6	9.2	8.9
110	15.8	14.9	13.9	13.0	11.7	11.2	9.8	9.5
115	16.7	15.7	14.6	13.7	12.4	11.9	10.4	10.0
120	17.6	16.5	15.5	14.4	13.1	12.5	11.0	10.6
125	18.5	17.4	16.3	15.1	13.9	13.1	11.7	11.2
130	19.4	18.1	17.1	15.8	14.6	13.8	12.3	11.8
135	20.3	19.0	17.9	16.5	15.4	14.4	13.0	12.4
140	21.3	19.8	18.7	17.2	16.2	15.0	13.6	12.9
145	22.3	20.6	19.6	17.9	17.0	15.7	14.3	13.5
150	23.4	21.5	20.5	18.6	17.9	16.3	15.0	14.0

Table 2.3: Statistical Stand Table Data for Beech: Minimum Stem Spacing (ft)

Age (year) \ Locality Class/ Method of Thinning	I/h	I/m	II/h	II/m	III/h	III/m	IV/h	IV/m
30	4.6	4.6	3.9	3.9	3.0	3.0	-	-
35	6.1	5.9	5.0	5.0	3.8	3.8	-	-
40	7.5	7.0	6.2	6.2	4.7	4.7	3.6	3.6
45	8.9	8.1	7.4	7.2	5.7	5.6	4.4	4.3
50	10.3	9.1	8.7	8.1	6.9	6.5	5.3	5.0
55	11.7	10.1	9.9	9.0	8.0	7.3	6.2	5.7
60	12.9	11.2	11.1	9.9	9.1	8.2	7.1	6.5
65	14.2	12.2	12.3	10.9	10.1	9.1	8.0	7.3
70	15.5	13.3	13.4	11.9	11.2	10.0	9.0	8.1
75	16.8	14.3	14.6	12.8	12.2	10.8	10.0	8.9
80	18.1	15.4	15.9	13.7	13.3	11.7	11.0	9.7
85	19.4	16.5	17.1	14.6	14.4	12.6	12.0	10.5
90	20.7	17.6	18.3	15.6	15.5	13.5	12.9	11.3
95	22.1	18.7	19.5	16.6	16.6	14.4	13.9	12.2
100	23.4	19.8	20.8	17.5	17.7	15.3	14.9	13.0
105	24.8	20.9	22.0	18.5	18.8	16.2	15.9	13.9
110	26.2	22.1	23.3	19.5	20.0	17.1	16.9	14.7
115	27.6	23.2	24.6	20.5	21.1	18.0	17.9	15.5
120	29.0	24.3	25.8	21.5	22.3	18.8	18.9	16.3
125	30.4	25.4	27.1	22.4	23.6	19.7	20.0	17.1
130	31.8	26.5	28.5	23.4	24.8	20.6	21.0	17.9
135	33.3	27.6	29.8	24.3	26.0	21.5	22.1	18.7
140	34.9	28.6	31.1	25.2	27.4	22.3	23.2	19.4
145	36.6	29.7	32.5	26.5	28.7	23.1	24.4	20.2
150	38.3	30.8	34.0	27.1	30.1	23.9	25.5	20.9

Table 3.1: Statistical Stand Table Data for Pine: Average Height (ft)

Age (years) \ Locality Class/ Method of Thinning	I/h	I/m	II/h	II/m	III/h	III/m	IV/h	IV/m	V/h	V/m	VI/m
25	34.4	33.9	28.5	28.0	21.7	21.4	-	-	-	-	-
30	41.0	40.1	34.4	33.5	26.9	26.3	19.7	19.4	12.1	12.2	6.6
35	-	46.4	-	38.8	-	30.9	-	23.0	-	15.1	-
40	53.1	51.6	44.6	43.4	36.1	35.2	27.2	26.6	18.0	17.8	10.9
45	-	56.9	-	47.7	-	39.1	-	29.9	-	20.4	-
50	64.0	62.2	53.5	52.0	44.0	42.8	33.8	32.9	23.6	23.0	15.1
55	-	66.4	-	55.9	-	46.0	-	35.9	-	25.7	-
60	72.8	71.0	61.0	59.5	50.5	49.3	39.4	38.5	28.5	28.0	18.7
65	-	74.7	-	62.8	-	52.3	-	41.1	-	30.3	-
70	80.1	78.0	67.6	65.8	56.4	54.9	44.6	43.4	33.1	32.2	21.4
75	-	80.9	-	68.4	-	57.2	-	45.4	-	34.2	-
80	85.6	83.5	72.8	71.0	61.0	59.5	48.6	47.4	36.7	35.9	23.7
85	-	85.8	-	73.3	-	61.5	-	49.0	-	37.5	-
90	89.9	88.1	76.8	75.3	64.6	63.5	51.5	50.7	39.7	38.8	25.7
95	-	90.1	-	77.3	-	65.1	-	52.3	-	40.1	-
100	93.5	92.1	80.4	79.3	67.6	66.8	54.1	53.6	41.7	41.1	27.3
105	-	94.1	-	80.9	-	68.4	-	54.9	-	42.1	-
110	96.8	95.7	83.7	82.6	70.2	69.7	56.8	56.2	43.0	42.8	28.6
115	-	97.4	-	83.9	-	71.0	-	57.6	-	43.4	-
120	99.7	98.7	86.0	85.2	72.5	72.4	58.7	58.5	44.3	44.1	29.9
125	-	100,3	-	86.5	-	73.3	-	59.5	-	44.7	-
130	102.4	101.6	88.6	87.8	74.8	74.3	60.4	60.2	45.6	45.4	30.9
135	-	102.6	-	88.8	-	75.3	-	60.8	-	46.0	-
140	104.3	103.6	90.6	89.8	76.4	76.0	61.7	61.5	46.9	46.7	31.6

Table 3.2: Statistical Stand Table Data for Pine: Average Stem Diameter (in)

Age (years) \ Locality Class/ Method of Thinning	I/h	I/m	II/h	II/m	III/h	III/m	IV/h	IV/m	V/h	V/m	VI/m
25	3.8	3.7	3.2	3.1	2.6	2.6	-	-	-	-	-
30	4.8	4.6	4.0	3.9	3.3	3.2	2.6	2.5	1.7	1.7	1.1
35	-	5.5	-	4.6	-	3.8	-	3.0	-	2.1	-
40	6.6	6.3	5.5	5.3	4.5	4.4	3.7	3.5	2.6	2.5	1.9
45	-	7.2	-	6.0	-	5.0	-	4.0	-	3.0	-
50	8.2	8.0	7.0	6.7	5.7	5.5	4.7	4.4	3.5	3.3	2.6
55	-	8.7	-	7.3	-	6.1	-	4.9	-	3.7	-
60	9.7	9.4	8.3	8.0	6.9	6.6	5.2	5.3	4.3	4.1	3.3
65	-	10.0	-	8.5	-	7.1	-	5.7	-	4.4	-
70	11.1	10.6	9.5	9.1	7.9	7.6	6.4	6.1	5.0	4.8	3.9
75	-	11.2	-	9.7	-	8.1	-	6.5	-	5.1	-
80	12.3	11.7	10.7	10.2	8.9	8.6	7.2	6.9	5.6	5.4	4.4
85	-	12.3	-	10.7	-	9.1	-	7.3	-	5.7	-
90	13.5	12.8	11.8	11.2	10.0	9.5	8.0	7.6	6.3	6.0	4.9
95	-	13.4	-	11.7	-	10.0	-	8.0	-	6.3	-
100	14.6	13.9	12.8	12.1	10.9	10.4	8.7	8.3	6.9	6.5	5.3
105	-	14.4	-	12.6	-	10.9	-	8.7	-	6.8	-
110	15.7	14.8	13.8	13.0	11.9	11.3	9.5	9.0	7.5	7.1	5.7
115	-	15.3	-	13.5	-	11.7	-	9.3	-	7.4	-
120	16.6	15.7	14.7	13.9	12.7	12.0	10.2	9.6	8.1	7.6	6.2
125	-	16.1	-	14.3	-	12.4	-	10.0	-	7.9	-
130	17.4	16.3	15.5	14.6	13.5	12.8	10.9	10.3	8.6	8.1	6.6
135	-	16.7	-	15.0	-	13.2	-	10.6	-	8.4	-
140	18.2	16.9	16.3	15.3	14.3	13.5	11.6	10.9	9.2	8.6	7.0

Table 3.3: Statistical Stand Table Data for Pine: Minimum Stem Spacing (ft)

Age (years) \ Locality Class/ Method of Thinning	I/h	I/m	II/h	II/m	III/h	III/m	IV/h	IV/m	V/h	V/m	VI/m
25	6.4	6.0	5.5	5.3	4.8	4.6	-	-	-	-	-
30	7.8	7.3	6.7	6.3	5.8	5.4	4.9	4.7	3.9	3.9	3.9
35		8.4		7.3		6.3		5.4		4.3	
40	10.6	9.5	9.1	8.3	7.8	7.1	6.7	6.0	5.2	4.8	4.6
45		10.7		9.3		7.8		6.7		5.3	
50	13.2	11.7	11.4	10.1	9.7	8.6	8.5	7.3	6.5	5.8	5.4
55		12.7		11.0		9.4		7.9		6.3	
60	15.6	13.6	13.6	11.9	11.6	10.1	9.7	8.4	7.8	6.8	6.2
65		14.5		12.7		10.9		9.1		7.3	
70	17.7	15.3	15.6	13.4	13.4	11.6	11.1	9.6	9.0	7.7	7.1
75		16.1		14.2		12.3		10.2		8.2	
80	19.7	16.9	17.4	14.9	15.4	13.0	12.4	10.7	10.1	8.7	7.9
85		17.6		15.7		13.7		11.2		9.2	
90	21.7	18.4	19.2	16.4	16.8	14.4	13.8	11.8	11.3	9.6	8.7
95		19.2		17.1		15.1		12.4		10.1	
100	23.6	19.9	21.0	17.8	18.6	15.8	15.3	13.0	12.4	10.6	9.6
105		20.7		18.5		16.6		13.6		11.1	
110	25.4	21.4	22.7	19.3	20.2	17.4	17.3	14.2	13.7	11.6	10.5
115		22.1		20.0		18.1		14.9		12.2	
120	27.0	22.7	24.4	20.8	21.9	18.9	18.1	15.6	14.9	12.8	11.5
125		23.3		21.5		19.7		16.4		13.5	
130	28.5	23.8	26.0	22.2	23.6	20.5	19.6	17.2	16.1	14.2	12.6
135		24.3		23.0		21.3		18.0		14.8	
140	30.0	24.8	27.5	23.7	25.1	22.2	21.1	18.9	17.4	15.5	13.9

Table 4.1: Statistical Stand Table Data for Spruce: Average Height (ft)

Age (years) \ Locality Class/ Method of Thinning	I/h	I/m	II/h	II/m	III/h	III/m	IV/m	V/m
20	27.9	23.3	17.7	16.7	12.8	12.8	-	-
25	34.4	30.2	24.0	22.0	18.4	16.7	-	-
30	39.7	37.7	30.5	28.2	22.3	20.3	13.8	-
35	48.6	46.3	37.4	35.1	27.6	24.9	18.0	-
40	57.1	54.5	44.9	42.0	32.8	30.5	22.6	14.8
45	65.0	62.3	51.8	48.9	39.7	37.1	27.2	18.4
50	72.5	69.6	58.7	55.4	45.6	43.0	32.2	22.3
55	78.7	75.8	65.0	61.7	50.9	48.2	37.1	26.2
60	84.3	81.0	70.5	67.3	55.8	53.1	41.7	30.5
65	88.9	85.6	75.5	72.2	60.4	57.7	45.9	34.4
70	93.2	89.9	79.7	76.4	64.6	62.0	49.9	38.4
75	97.1	93.8	83.7	80.4	68.6	65.9	53.5	42.0
80	100.7	97.4	87.3	84.0	72.2	69.6	56.8	45.3
85	104.0	100.7	90.6	87.3	75.5	72.8	60.0	48.6
90	107.0	103.7	93.8	90.6	78.7	76.1	63.0	51.5
95	109.9	106.6	96.8	93.5	81.7	79.1	65.9	54.1
100	112.5	109.3	99.4	96.1	84.6	82.0	68.9	56.4
105	114.8	111.9	102.7	98.8	87.6	85.0	71.5	-
110	117.1	114.2	104.3	101.0	90.2	87.6	74.1	-
115	119.4	116.1	106.6	103.3	92.8	90.2	76.4	-
120	121.1	117.8	108.9	105.3	95.1	92.5	78.7	-

Table 4.2: Statistical Stand Table Data for Spruce: Minimum Stem Diameter (in)

Age (years) \ Locality Class/ Method of Thinning	I/h	I/m	II/h	II/m	III/h	III/m	IV/m	V/m
20	3.0	3.0	2.6	2.6	1.8	1.8	-	-
25	4.0	3.7	3.3	3.1	2.5	2.4	-	-
30	4.8	4.5	4.0	3.8	3.1	3.0	2.5	-
35	5.6	5.3	4.8	4.5	3.8	3.5	2.8	-
40	6.5	6.1	5.5	5.3	4.4	4.1	3.3	2.7
45	7.3	6.9	6.2	5.9	5.1	4.6	3.7	3.0
50	8.1	7.6	6.9	6.6	5.8	5.0	4.2	3.3
55	9.0	8.3	7.7	7.2	6.3	5.6	4.6	3.7
60	9.9	9.1	8.4	7.8	7.2	6.0	5.0	4.1
65	10.8	9.8	9.2	8.4	8.0	6.6	5.4	4.4
70	11.7	10.6	10.0	9.0	8.7	7.1	5.9	4.8
75	12.6	11.3	10.9	9.7	9.5	7.6	6.3	5.1
80	13.5	12.1	11.7	10.4	10.2	8.1	6.6	5.4
85	14.3	12.8	12.4	11.0	10.8	8.6	7.0	5.7
90	15.2	13.5	13.1	11.6	11.4	9.2	7.4	5.9
95	16.0	14.1	13.8	12.2	12.0	9.7	7.7	6.2
100	16.7	14.8	14.4	12.9	12.4	10.2	8.0	6.4
105	17.4	15.4	15.1	13.5	13.1	10.7	8.3	-
110	18.1	16.1	15.7	14.1	13.6	11.2	8.6	-
115	18.9	16.7	16.3	14.8	14.2	11.7	8.9	-
120	19.6	17.4	16.9	15.5	14.8	12.3	9.1	-

Table 4.1: Statistical Stand Table Data for Spruce: Average Height (ft)

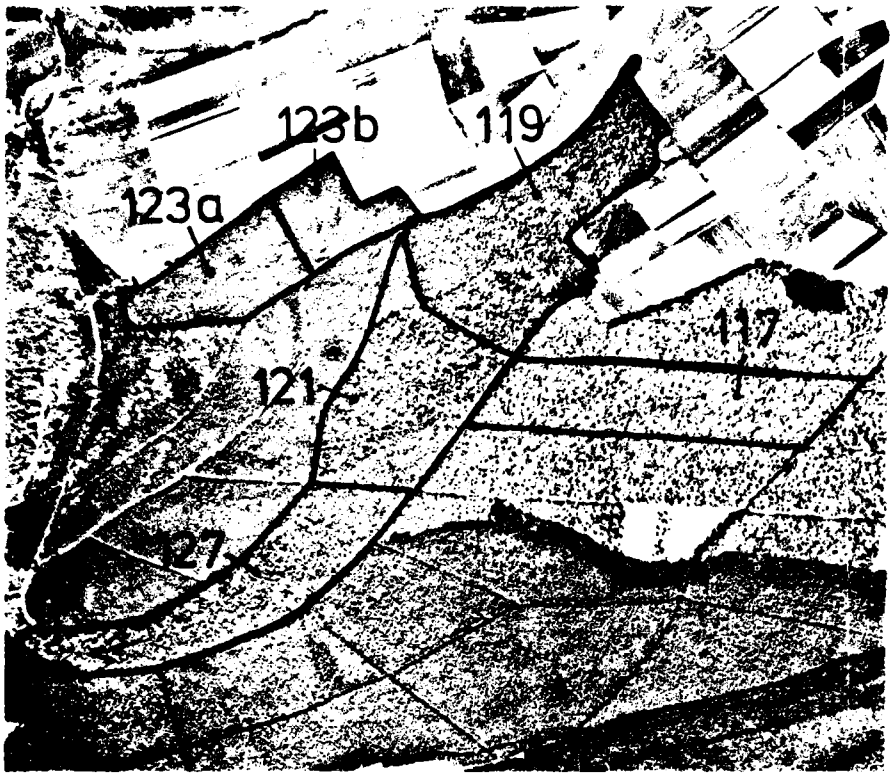
Age (years) \ Locality Class/ Method of Thinning	I/h	I/m	II/h	II/m	III/h	III/m	IV/m	V/m
20	27.9	23.3	17.7	16.7	12.8	12.8	-	-
25	34.4	30.2	24.0	22.0	18.4	16.7	-	-
30	39.7	37.7	30.5	28.2	22.3	20.3	13.8	-
35	48.6	46.3	37.4	35.1	27.6	24.9	18.0	-
40	57.1	54.5	44.9	42.0	32.8	30.5	22.6	14.8
45	65.0	62.3	51.8	48.9	39.7	37.1	27.2	18.4
50	72.5	69.6	58.7	55.4	45.6	43.0	32.2	22.3
55	78.7	75.8	65.0	61.7	50.9	48.2	37.1	26.2
60	84.3	81.0	70.5	67.3	55.8	53.1	41.7	30.5
65	88.9	85.6	75.5	72.2	60.4	57.7	45.9	34.4
70	93.2	89.9	79.7	76.4	64.6	62.0	49.9	38.4
75	97.1	93.8	83.7	80.4	68.6	65.9	53.5	42.0
80	100.7	97.4	87.3	84.0	72.2	69.6	56.8	45.3
85	104.0	100.7	90.6	87.3	75.5	72.8	60.0	48.6
90	107.0	103.7	93.8	90.6	78.7	76.1	63.0	51.5
95	109.9	106.6	96.8	93.5	81.7	79.1	65.9	54.1
100	112.5	109.3	99.4	96.1	84.6	82.0	68.9	56.4
105	114.8	111.9	102.7	98.8	87.6	85.0	71.5	-
110	117.1	114.2	104.3	101.0	90.2	87.6	74.1	-
115	119.4	116.1	106.6	103.3	92.8	90.2	76.4	-
120	121.1	117.8	108.9	105.3	95.1	92.5	78.7	-

Table 4.3: Statistical Stand Table Data for Spruce: Minimum Stem Spacing (ft)

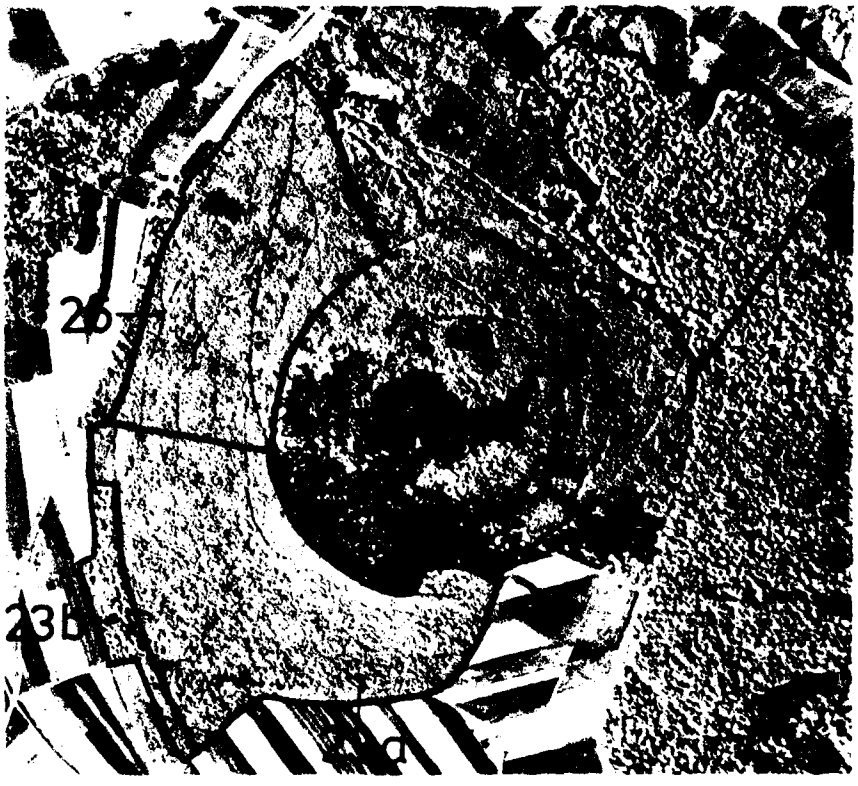
Age (years) \ Locality Class/ Method of Thinning	I/h	I/m	II/h	II/m	III/h	III/m	IV/m	V/m
20	5.6	4.8	5.4	4.8	4.8	4.8	-	-
25	6.8	5.7	6.2	5.4	5.5	4.8	-	-
30	7.8	6.7	7.0	6.1	6.1	5.3	4.8	-
35	8.9	7.6	7.9	6.9	6.9	5.8	5.4	-
40	9.9	8.5	8.8	7.7	7.7	6.4	6.0	5.3
45	10.8	9.4	9.6	8.5	8.5	7.0	6.4	5.6
50	11.8	10.2	10.5	9.1	9.3	7.5	6.8	6.0
55	12.8	10.9	11.3	9.8	10.2	8.1	7.2	6.4
60	13.8	11.7	12.2	10.4	11.1	8.6	7.6	6.8
65	14.9	12.5	13.2	11.0	12.1	9.2	8.1	7.2
70	15.9	13.2	14.2	11.7	13.1	9.7	8.6	7.7
75	17.0	14.0	15.3	12.5	14.0	10.3	9.1	8.1
80	18.2	14.8	16.4	13.2	15.0	10.9	9.6	8.5
85	19.3	15.5	17.4	14.0	15.9	11.6	10.0	8.9
90	20.4	16.3	18.3	14.7	16.7	12.3	10.6	9.3
95	21.4	17.0	19.3	15.5	17.6	13.0	11.1	9.8
100	22.4	17.8	20.1	16.3	18.4	13.7	11.6	10.2
105	23.3	18.6	21.0	17.2	19.2	14.5	12.1	-
110	24.2	19.4	21.8	18.1	20.0	15.3	12.6	-
115	25.1	20.2	22.7	19.0	20.8	16.1	13.1	-
120	26.0	21.1	23.5	19.9	21.6	17.0	13.7	-

Photograph 1: Typical Beech Understory Associated with Beech Overstory

Photograph 2: Beech Stocking Area Associated with Limestone Bedrock (Flight No. 2193/455)



Photograph 3: Forest Compartments Investigated Within the Grebenau Forest Office Area (Flight No. 2193/493)



Photograph 4: Forest Compartments Investigated Within the Burghaun Forest Office Area (Flight No. 2191/133)

APPENDIX A: Forestry Office Invenvory Data
for 90 Sites Selected

Forest Office: Hünfeld Dominant Species: Oak Inventory Date: 1 Oct 1962

Site No.	No. of Compartment	Total Area (ha)	Altitude Above Sea Level (ft)	Slope	Surface Soil Type	Nutrient Supply	Water Economy	Species	Area (ha)	Composition (%)	Age (years)	Height (ft)	Locality Class	Canopy Closure (%)	Remarks
28	90d	1.9	-	-	-	-	1	Oak	1.7	90	64	60.7	II	>90-100	
								Beech	0.2	10	64	60.7	II/III	>90-100	
30	93d	1.1	-	-	-	-	1	Oak	0.8	70	100	75.4	II	>50-70	
								Beech	0.3	30	90	75.4	III	>50-70	
29	92a	0.5	-	-	-	-	2	Oak	0.4	80	95	72.1	II	>50-70	
								Beech	0.1	20	95	72.1	III	>50-70	
27	92b	5.0	-	-	-	-	2	Oak	3.2	75	44	39.3	II/III	> 100	
								Beech	1.8	25	44	39.3	II/III	> 100	

Forest Office: Burghaun Dominant Species: Oak Inventory Date: 1 Jan 1975

Site No.	No. of Compartment	Total Area (ha)	Altitude Above Sea Level (ft)	Slope (%)	Surface Soil Type	Nutrient Supply	Water Economy	Species	Area (ha)	Composition (%)	Age (years)	Height (ft)	Locality Class	Canopy Closure (%)	Remarks
11	33a	0.4	1147.5 – 1196.7	0-9	ML	2	6	Oak	0.2	60	90	75.4	I/II	>75-90	
								Beech	0.2	40	90	78.7	II/III	>75-90	
10	38a	1.1	1180.3	0	SM	3	1	Oak	1.1	100	25	26.2	I/II	>100	
4	2d	1.2	1213.1 – 1229.5	0	SM	-	-	Oak	1.2	58	58	48.5	II/III	> 100	
18	$77c_1$	1.7	1147.5 – 1213.1	0-9	SM	2	2	Oak	1.6	95	115	82.0	II	>50-70	
								spruce	0.1	5	115	93.4	II/III	>50-70	
								spruce	0.1	100	60	32.8	V	< 50	Understory

Forest Office: Schlitz Dominant Species: Oak Inventory Date: 1 Jan 1975

Site No.	No. of Compartment	Total Area (ha)	Altitude Above Sea Level (ft)	Slope (%)	Surface Soil Type	Nutrient Supply	Water Economy	Species	Area (ha)	Composition (%)	Age (years)	Height (ft)	Locality Class	Canopy Closure (%)	Remarks
60	$406d_2$	0.2	950.8 - 1114.8	17-36	SM	2	2	Oak	0.2	100	22	-	I	>100	
57	$518c_3$	0.3	819.7 - 1016.4	17-58	SM	2	1	Oak	0.2	60	50	-	II	>75-90	
								Beech	0.1	40	40	-	III	>75-90	
55	$518a_3$	0.4	1016.4 - 1049.2	3-17	SM	3	3	Oak	0.4	100	81	68.9	II	>90-100	
63	$22a_2$	0.5	819.7 - 918.0	17-36 +) - 58-100	SM	2	1	Oak	0.5	100	129	88.5	I/II	>75-90	
								Spruce	-	100	80	-	III	< 50	Understory

+) different slopes were encountered within the same compartment

Forest Office: Grebenau Dominant Species: Oak Inventory Date: 1 Jan 1975

Site No.	No. of Compartment	Total Area (ha)	Altitude Above Sea Level (ft)	Slope (%)	Surface Soil Type	Nutrient Supply	Water Economy	Species	Area (ha)	Composition (%)	Age (years)	Height (ft)	Locality Class	Canopy Closure (%)	Remarks
71	80d	0.4	1049.2 - 1065.6	9-36	SM	2	1	Oak	0.3	70	113	82.0	II	>75-90	
								Beech	0.1	30	113	72.1	IV	>75-90	

Forest Office: Hünfeld Dominant Species: Beech Inventory Date: 1 Oct 1962

Site No.	No. of Compartment	Total Area (ha)	Altitude Above Sea Level (ft)	Slope (%)	Surface Soil Type	Nutrient Supply	Water Economy	Species	Area (ha)	Composition (%)	Age (years)	Height (ft)	Locality Class	Canopy Closure (%)	Remarks
21	69b	5.2	-	-	-	-	1	Beech	4.7	90	114	85.2	II	>75-90	
								Oak	0.3	5	124	82.0	II/III	>75-90	
								Spruce	0.2	5	96	88.5	II/III	>75-90	
24	75a	5.6	-	-	-	-	1	Beech	2.5	40	17	-	II/III	> 100	
								Oak	2.0	30	15	-	II	> 100	
								Spruce	1.1	20	8	-	II	> 100	
37	40a	15.2	-	-	ML	-	1	Beech	14.4	95	144	-	III	>50-70	
								Oak	0.8	5	144	-	II/III	>50-70	
25	86b	4.0	-	-	-	-	2	Beech	3.6	90	30	-	II/III	>90-100	
								Spruce	0.4	10	30	-	II/III	>90-100	

Forest Office: Burnhaun Dominant Species: Beech Inventory Date: 1 Jan 1975

Site No.	No. of Compartment	Total Area (ha)	Altitude range (ft)	Slope (°)	Soil Type	Fertility Class	Water Economy	Species	Area (ha)	Composition (%)	Age (years)	Height (ft)	Locality Class	Canopy Closure (%)	Remarks
8	28c	4.3	1213.1 - 1362.3	3-9	ML	1	1	Beech	2.1	50	79	86.9	I/II	> 100	
								Oak	1.9	45	79	86.9	I	> 100	
								Pine	0.2	5	79	78.7	I/II	> 100	
6	21a	15.6	1409.8 - 1718.0	9-36	-	1	1	Beech	12.4	75	83	78.7	II	> 100	
								Oak	0.8	5	83	72.1	I/II	> 100	
								Pine	3.3	20	78	82.0	II	> 100	
9	29a	11.6	1114.8 - 1213.1	3-9	ML	1	1	Beech	9.6	85	18	-	II	> 100	
								Oak	2.0	15	18	-	I/II	> 100	
3	1	10.3	1377.0 - 1573.8	9-36	ML	1	1	Beech	10.3	100	49	49.2	II	> 100	
5	4a	10.3	1229.5 - 1442.6	3-9 17-36	ML	1	1	Beech	9.2	90	125	98.4	II/III	>50-70	
								Oak	1.0	10	125	86.9	I/II	>50-70	
								Beech	0.1	100	10	-	II	< 50	Understory

Forest Office: Schlitz Dominant Species: Beech Inventory Date: 1 Jan 1975

Site No.	No. of Compartment	Total Area (ha)	Altitude Above Sea Level (ft)	Slope (%)	Surface Soil Type	Nutrient Supply	Water Economy	Species	Area (ha)	Composition (%)	Age (years)	Height (ft)	Locality Class	Canopy Closure (%)	Remarks
62	439a$_1$	7.6	1442.6 – 1506.6	9-36	ML-SM	2	1	Beech	4.3	60	97	85.2	II	> 100	
								Oak	2.1	30	97	83.6	I	> 100	
								Spruce	0.4	6	89	95.1	I/II	> 100	
								Pine	0.3	4	97	101.6	I/II	> 100	
54	535/2	1.5	1049.2 – 1213.1	9-36	ML-SM	2	1	Beech	1.5	100	129	-	II	>50-70	
50	531/1	6.3	983.6 – 1311.5	17-58	ML-SM	2	1	Beech	6.3	100	147	101.6	II/III	> 75-90	
								Spruce	-	-	49	45.9	III	-	Spotted
61	447c	2.4	1114.8 – 1278.7	17-36	ML-SM	2	1	Beech	1.4	60	20	-	II/III	> 100	
								Oak	0.5	20	20	-	I/II	> 100	
								Spruce	0.5	20	13	-	II	> 100	
42	706a	4.3	918.0 – 1016.4	9-17	ML-SM	2	2	Beech	2.8	70	49	59.0	I	> 100	
								Pine	1.3	30	49	78.7	I	> 100	
								Pine	0.2	100	153	-	I	> 100	Understory
65	910a	4.3	1245.9 – 1426.2	17-36	ML-SM	2	1	Beech	2.5	100	170	105.2	II/III	> 50-70	

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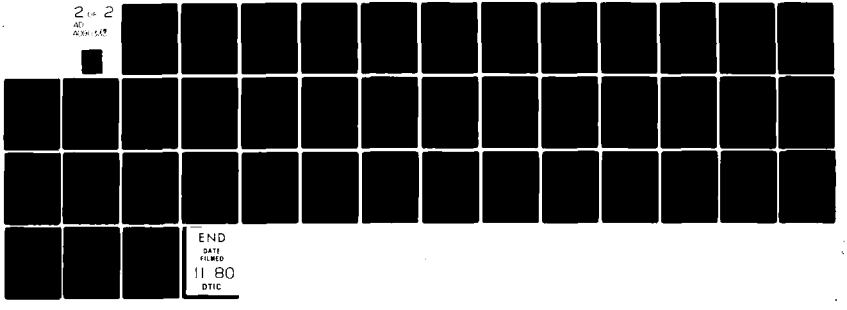

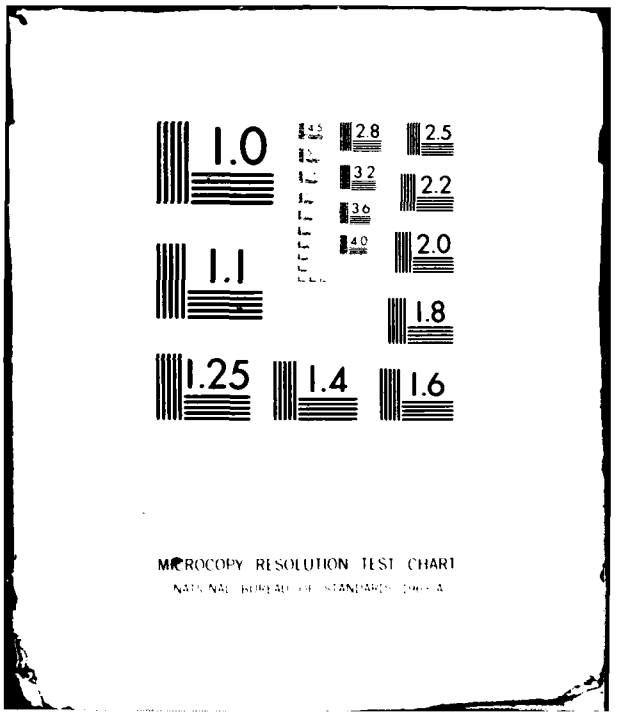
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Forest Office: Grebenau Dominant Species: Beech Inventory Date: 1 Jan 1975

Site No.	No. of Compartment	Total Area (ha)	Altitude Above Sea Level (ft)	Slope (%)	Surface Soil Type	Nutrient Supply	Water Economy	Species	Area (ha)	Composition (%)	Age (years)	Height (ft)	Locality Class	Canopy Closure (%)	Remarks
75	134	3.6	1409.8 - 1475.4	3-9	ML	1	3	Beech	2.9	90	33	-	III	> 100	
								Pine	0.2	7	24	-	II/III	> 100	
								Spruce	0.1	3	24	-	II	> 100	
69	26	2.8	1447.5 - 1213.1	3-17	SM	2	2	Beech	2.0	70	87	90.2	I/II	> 100	
								Spruce	0.6	20	65	-	< I	> 100	
								Pine	0.2	10	65	-	I	> 100	
84	162b	1.0	1311.5 - 1409.8	0-17	SM	2	3	Beech	1.0	100	85	67.2	III	>75-90	
83	171a	0.6	1245.9 - 1278.7	0-17	SM	2	6	Beech	0.6	100	55	49.2	II/III	> 100	

Forest Office: Hünfeld Dominant Species: Pine Inventory Date: 1 Oct 1962

Site No.	No. of Compartment	Total Area (ha)	Altitude Above Sea Level (ft)	Slope (%)	Surface Soil Type	Nutrient Supply	Water Economy	Species	Area (ha)	Composition (%)	Age (years)	Height (ft)	Locality Class	Canopy Closure (%)	Remarks
33	7c	4.0	-	-	ML	-	4	Pine	3.4	85	109	78.7	I/II	>75-90	
								Oak	0.2	5	109	75.4	II	>75-90	
								Beech	0.4	10	90	70.5	III	>75-90	
34	9a	7.2	-	-	SM	-	4	Pine	6.5	90	28	34.4	-	> 100	
								Beech	0.7	10	28	34.4	-	> 100	
36	47c	2.1	-	-	SM-ML	-	3	Pine	1.8	85	62	57.4	II	>90-100	
								Beech	0.2	10	62	50.8	II/III	>90-100	
								Spruce	0.1	5	62	50.8	II/III	>90-100	
41	189c	1.8	-	-	SM	-	4	Pine	1.8	100	118	82.0	II	>50-70	

Forest Office: Burghaun Dominant Species: Pine Inventory Date: 1 Jan 1975

Site No.	No. of Compartment	Total Area (ha)	Altitude Above Sea Level (ft)	Slope (%)	Surface Soil Type	Nutrient Supply	Water Economy	Species	Area (ha)	Composition (%)	Age (years)	Height (ft)	Locality Class	Canopy Closure (%)	Remarks
16	59a	4.2	1295.1 - 1344.3	0	SM	3	6	Pine	3.4	80	26	29.5	I/II	> 100	
								Pine	0.4	10	25	39.3	II	> 100	
								Oak	0.4	10	26	-	II	> 100	
17	60c	6.6	1327.9 - 1344.3	0	SM	3	6	Pine	6.6	100	73	62.3	II/III	>90-100	
15	58	16.7	1295.1 - 1327.9	0-9	SM-ML	3	6	Pine	16.5	100	113	78.7	II/III	>75-90	
								Oak	0.1	-	113	73.8	II/III	>75-90	
								Spruce	0.1	-	113	73.8	IV	>75-90	
14	63	7.4	1114.8 - 1245.9	3-9	SM-ML	2	1	Pine	6.5	90	60	78.7	I	> 100	
								Beech	0.9	10	60	72.1	I	> 100	

Forest Office: Schlitz Dominant Species: Pine Inventory Date: 1 Jan 1975

Site No.	No. of Compartment	Total Area (ha)	Altitude Above Sea Level (ft)	Slope (%)	Surface Soil Type	Nutrient Supply	Water Economy	Species	Area (ha)	Composition (%)	Age (years)	Height (ft)	Locality Class	Canopy Closure (%)	Remarks
64	935b	4.3	1393.4 - 1409.8	0-9	SM above ML	3	6	Pine	4.0	93	23	-	II	> 100	
								Spruce	0.2	5	20	-	II	> 100	
								Beech	0.1	2	25	-	III	> 100	
43	726a	3.0	1000.0 - 1098.4	3-17	SM	2	1	Pine	2.0	90	66	80.3	I	> 100	
								Spruce	0.2	10	66	77.0	I/II		
								Beech	-	80	20	-	III	< 50	Understory
								Spruce	-	20	20	-	III	< 50	Understory
47	607a	11.8	1114.8 - 1229.5	3-17	SM above ML	3	1	Pine	11.8	100	93	83.6	I/II	> 100	
								Beech	-	50	20	-	III/IV	< 50	Understory
								Spruce	-	80	15	-	III	< 50	Understory
								Beech	-	20	60	-	IV	< 50	Understory
67	$921b_2$	1.4	1163.9 - 1229.5	3-17	SM	2	1	Pine	1.3	95	110	91.8	I/II	>90-100	
								Beech	0.1	5	100	68.9	III/IV	>90-100	
58	460d	2.5	1032.8 - 1147.5	17-58	SM-ML	2	1	Pine	1.8	70	114	85.2	II	100	
								Beech	0.5	20	114	87.5	III	100	
								Beech	0.2	10	90	65.6	III/IV	100	

Forest Office: Grebenau Dominant Species: Pine Inventory Date: 1 Jan 1975

Site No.	No. of Compartment	Total Area (ha)	Altitude Above Sea Level (ft)	Slope (%)	Surface Soil Type	Nutrient Supply	Water Economy	Species	Area (ha)	Composition (%)	Age (years)	Height (ft)	Locality Class	Canopy Closure (%)	Remarks
73	96a	7.9	1147.5 - 1213.1	3-17	SM	3	1	Pine	7.9	100	19	-			
81	149a	4.4	1213.1 - 1344.3	3-17	SM	2	1	Pine	4.2	90	96	83.6	I/II	>90-100	
								Spruce	0.5	5	96	88.5	II/III	>90-100	
								Beech	0.5	5	96	83.6	II/III	>90-100	
								Beech	-	100	-	59.5	IV	< 50	Understory
79	151a	5.6	1245.9 - 1344.3	0-3 9-17	SM	2	1	Pine	5.6	100	7	-	II	> 100	
72	89b	5.2	1278.7 - 1311.5	17-58	ML-SM	2	3	Pine	5.1	100	41	59.0	II/III	> 100	
								Spruce	0.1	-	41	65.6	II	> 100	
74	$228a_2$	2.1	1016.4 - 1114.8	3-17	SM	2	1	Pine	2.1	100	148	86.9	II	>90-100	
								Beech	2.1	100	100	49.2	IV	< 50	Understory
80	$153a_1$	5.2	1131.1 - 1245.9	0-3 9-17	SM	2	1	Pine	3.6	70	84	82.0	I/II	>90-100	
								Spruce	1.6	30	84	101.6	I	>90-100	

Forest Office: Grebenau Dominant Species: Pine Inventory Date: 1 Jan 1975

Site No.	No. of Compartment	Total Area (ha)	Altitude Above Sea Level (ft)	Slope (%)	Surface Soil Type	Nutrient Supply	Water Economy	Species	Area (ha)	Composition (%)	Age (years)	Height (ft)	Locality Class	Canopy Closure (%)	Remarks
78	160	4.3	1245.9 - 1344.3	0-9	SM	3	1	Pine	4.3	100	35	-	II/III	> 100	
86	152	7.9	1131.1 - 1245.9	0-3 9-17	SM	2	1	Pine	7.9	100	22	-	I/II	> 100	
87	154	4.8	1245.9 - 1311.5	0-3 9-17	SM	2	1	Pine	3.6	75	84	80.3	I	> 100	
								Spruce	1.2	25	84	98.4	I	> 100	
85	166b$_1$	5.7	1311.5 - 1344.3	0-9	SM above SC	3	6	Pine	4.0	70	19	45.9	II	> 100	
								Spruce	1.7	30	17	45.7	II/III	> 100	

Forest Office: Hünfeld Dominant Species: Spruce Inventory Date: 1 Oct 1962

Site No.	No. of Compartment	Total Area (ha)	Altitude Above Sea Level (ft)	Slope (%)	Surface Soil Type	Nutrient Supply	Water Economy	Species	Area (ha)	Composition (%)	Age (years)	Height (ft)	Locality Class	Canopy Closure (%)	Remarks
40	21	11.3	-	-	-	-	9	Spruce	11.3	100	80	73.8	II/III	>90-100	
39	32c	7.0	-	-	-	-	3	Spruce	6.0	85	89	82.0	II/III	> 75-90	
								Spruce	0.7	10	59	72.1	II	> 75-90	
								Pine	0.3	5	99	82.0	II	> 75-90	
32	33	11.6	-	-	-	-	4	Spruce	11.6	100	52	55.7	II	> 100	
31	51b	1.1	-	-	ML	-	3	Spruce	0.9	80	19	-	-	>90-100	
								Beech	0.2	20	15	-	-	>90-100	

Forest Office: Burghaun Dominant Species: Spruce Inventory Date: 1 Jan 1975

Site No.	No. of Compartment	Total Area (ha)	Altitude Above Sea Level (ft)	Slope (%)	Surface Soil Type	Nutrient Supply	Water Economy	Species	Area (ha)	Composition (%)	Age (years)	Height (ft)	Locality Class	Canopy Closure (%)	Remarks
7	22a	14.0	1475.4 - 1718.0	9-17 36-58	ML	1	3	Spruce	9.8	70	65	72.1	II	> 100	
								Beech	2.8	20	65	75.4	I	> 100	
								Oak	1.4	10	65	72.1	I	> 100	
20	77c	2.7	1147.5 - 1213.1	0-3 9-17	SM	2	2	Spruce	2.7	100	115	104.9	II	> 90-100	
12	37d	2.8	1147.5 - 1213.1	0	SM-ML	2	2	Spruce	2.2	80	46	80.3	< I	> 100	
								Pine	0.6	20	46	75.4	I	> 100	
13	34d	3.9	1295.1 - 1360.7	3-9	SM-ML	2	1	Spruce	3.9	100	22	25.4	II	> 100	

Forest Office: Schlitz Dominant Species: Spruce Inventory Date: 1 Jan 1975

Site No.	No. of Compartment	Total Area (ha)	Altitude Above Sea Level (ft)	Slope (%)	Surface Soil Type	Nutrient Supply	Water Economy	Species	Area (ha)	Composition (%)	Age (years)	Height (ft)	Locality Class	Canopy Closure (%)	Remarks
53	540a$_2$	1.2	983.6 - 1147.5	36-58	SM	3	4	Spruce	1.2	100	79	68.9	III	>90-100	
44	735b$_1$	2.2	819.7 - 852.5	3-9 17-36	SM-ML	3	1	Spruce	1.8	95	24	-	II	> 100	
								Pine	0.4	5	24	-	II	>100	
48	527a	3.0	1344.3 - 1360.7	0-9	SM above ML	3	6	Spruce	3.0	100	51	75.4	< I	> 100	
51	533b	2.0	1311.5 - 1344.3	0-9	SM above ML	2	1	Spruce	2.0	100	69	83.6	I/II	>90-100	
52	527c$_1$	3.3	1344.3	0	SM above CL	2	1	Spruce	1.9	57	101	106.6	I	> 50-70	
								Beech	1.4	43	119	101.6	II	>50-70	
								Spruce	3.3	100	5	-	I	< 50	Understory
45	755b$_1$	2.2	819.7 - 852.5	3-9 17-36	SM above ML	3	1	Spruce	2,0	95	24	-	II	> 100	
								Pine	0,2	5	24	-	II	> 100	

Forest Office: Grebenau Dominant Species: Spruce Inventory Date: 1 Jan 1975

Site No.	No. of Compartment	Total Area (ha)	Altitude Above Sea Level (ft)	Slope (%)	Surface Soil Type	Nutrient Supply	Water Economy	Species	Area (ha)	Composition (%)	Age (years)	Height (ft)	Locality Class	Canopy Closure (%)	Remarks
88	1a	4.8	918.0 - 1114.8	0-3 9-17	SM	2	3	Spruce	4.6	95	79	68.9	III	>90-100	
								Pine	0.2	5	79	-	II	>90-100	
89	151	1.1	1245.9 - 1344.3	0-3 9-17	SM	2	1	Spruce	1.1	100	28	-	I/II	> 75-90	
77	318b	2.8	1213.1 - 1278.7	0-3 9-17	SM	2	2	Spruce	1.8	66	121	115.1	I/II	> 100	
								Pine	1.0	34	121	93.4	I/II	> 100	
82	150a	3.0	1344.3	0	SM	2	1	Spruce	3.0	100	67	85.2	I/II	>90-100	

Forest Office: Hünfeld Dominant Species: Mixed Forest Inventory Date: 1 Oct 1962

Site No.	No. of Compartment	Total Area (ha)	Altitude Above Sea Level (ft)	Slope (%)	Surface Soil Type	Nutrient Supply	Water Economy	Species	Area (ha)	Composition (%)	Age (years)	Height (ft)	Locality Class	Canopy Closure (%)	Remarks
35	10a	14.4	-	-	ML	-	1	Pine	10.1	70	119	86.9	II	>75-90	
								Beech	3.6	25	85	68.9	III	>75-90	
								Oak	0.7	5	119	80.3	II	>75-90	
22	68b	4.3	-	-	-	-	1	Beech	2.6	60	104	85.2	II/III	>50-70	
								Spruce	1.7	40	96	93.4	II	>50-70	
23	74b	2.4	-	-	ML	-	2	Spruce	1.7	70	51	60.7	I/II	> 100	
								Beech	0.7	30	51	55.7	II	> 100	
26	85a	12.3	-	-	-	-	1	Beech	8.6	70	49	-	II	> 100	
								Oak	0.6	5	49	-	II	> 100	
								Spruce	3.1	25	25	-	I/II	> 100	
38	19	1.1	-	-	SM	-	4	Oak	0.6	50	125	72.1	III	>50-70	
								Beech	0.2	20	110	72.1	III/IV	>50-70	
								Pine	0.3	30	110	73.8	II/III	>50-70	

Forest Office: Burghaun Dominant Species: Mixed Forest Inventory Date: 1 Jan 1975

Site No.	No. of Compartment	Total Area (ha)	Altitude Above Sea Level (ft)	Slope (%)	Surface Soil Type	Nutrient Supply	Water Economy	Species	Area (ha)	Composition (%)	Age (years)	Height (ft)	Locality Class	Canopy Closure (%)	Remarks
19	17f	1.2	1213.1 - 1262.3	0-9	SM-ML	2	2	Oak	0.5	45	20	-	I	> 100	
								Beech	0.3	25	20	-	I	> 100	
								Pine	0.3	30	20	-	I	> 100	
								Oak	0.1	100	134	75.4	III	>100	Understory
2	221b	2.6	1114.8 - 1245.9	3-17	ML	1	3	Beech	1.6	60	149	77.0	IV	>50-70	
								Pine	1.0	40	149	62.3	IV	>50-70	
1	222d	1.0	1245.9 - 1262.3	3-9	ML	1	3	Pine	0.6	60	50	47.5	II/III	> 100	
								Beech	0.4	40	48	45.9	II/III	> 100	
								Pine	-	-	169	72.1	III/IV	-	

Forest Office: Schlitz Dominant Species: Mixed Forest Inventory Date: 1 Jan 1975

Site No.	No. of Compartment	Total Area (ha)	Altitude Above Sea Level (ft)	Slope (%)	Surface Soil Type	Nutrient Supply	Water Economy	Species	Area (ha)	Composition (%)	Age (years)	Height (ft)	Locality Class	Canopy Closure (%)	Remarks
59	442a$_1$	3.2	1082.0 – 1311.5	3-9 58-100	SM	2	1	Pine	2.3	70	122	90.2	I/II	> 100	
								Beech	0.9	30	122	96.7	II/III	> 100	
49	528a	5.0	1311.5 – 1360.7	3-9	SM above CL	2	2	Beech	3.2	65	99	100.0	I/II	> 100	
								Spruce	1.2	25	91	103.3	I	> 100	
								Pine	0.2	5	91	90.2	II/III	> 100	
								Oak	0.3	5	99	83.6	I	> 100	
56	513b	3.8	918.0 – 983.6	17-58	ML-SM	2	2	Spruce	1.4	63	69	93.4	< I	>90-100	
								Beech	0.5	22	89	72.1	III	>90-100	
								Spruce	0.4	15	50	65.6	I/II	>90-100	
66	914d$_2$	1.9	1082.0 – 1245.9	3-17	SM	2	1	Beech	1.0	55	138	95.1	III	> 100	
								Pine	0.9	45	138	91.8	II	> 100	
46	755a$_2$	0.8	885.2 – 983.6	3-17	SM-ML	2	1	Spruce	0.5	63	34	-	I/II	> 100	
								Beech	0.2	25	34	-	III	> 100	
								Oak	0.1	12	34	-	II	> 100	

Forest Office: Grebenau Dominant Species: Mixed Forest Inventory Date: 1 Jan 1975

Site No.	No. of Compartment	Total Area (ha)	Altitude Above Sea Level (ft)	Slope (%)	Surface Soil Type	Nutrient Supply	Water Economy	Species	Area (ha)	Composition (%)	Age (years)	Height (ft)	Locality Class	Canopy Closure (%)	Remarks
68	8a	4.7	1311.5 - 1344.3	0-9	SM	2	1	Oak	2.4	50	104	77.0	II	> 100	
								Spruce	0.9	20	104	86.9	III	> 100	
								Pine	1.4	30	104	85.2	I/II	> 100	
70	19a	1.3	1213.1 - 1311.5	9-36	SM	2	1	Oak	0.6	40	78	70.5	I/II	> 100	
								Beech	0.5	40	78	77.0	II	> 100	
								Spruce	0.9	20	78	93.4	I/II	> 100	
90	136a	3.5	1311.5 - 1344.3	0-3 9-17	ML	1	3	Beech	1.9	55	20	-	III	>90-100	
								Pine	0.7	20	8	-	II/III	>90-100	
								Spruce	0.9	35	20	-	II	>90-100	
76	325b	5.5	1114.8 - 1213.1	3-17	SM	2	2	Beech	2.8	51	64	73.8	I/II	> 100	
								Pine	2.7	49	59	82.0	I	> 100	

APPENDIX B: Vegetation Field Data
for 13 Sites Selected

SITE NO: 68 DATE: 1/8/79

11. GENERAL FOREST DESCRIPTION

☐ NO FOREST (GO TO BLOCK 13) ☐ CONFIEROUS ☒ DECIDUOUS ☐ MIXED

APPROXIMATE COMPOSITION

	COMMON NAME	APPROX. PERCENT OF STEMS					
		100	75-99	50-74	26-50	10-25	<10
1	oak	☐	☐	☒	☐	☐	☐
2	beech	☐	☐	☐	☐	☐	☒
3	pine	☐	☐	☐	☐	☒	☐

11a. MANAGEMENT

☐ INDETERMINATE ☐ NATURAL ☒ NATURAL, MANAGED ☐ THINNED

☐ SEEDED, BROADCAST ☐ ROW-PLANTED ☐ _____

11b. GROWTH STAGE

☐ INDETERMINATE ☒ MATURE

FOR SEEDED/PLANTED FOREST: ☐ RECENTLY REPLANTED ☐ INTERMEDIATE

FOR NATURAL FOREST: ☐ EARLY SECOND GROWTH ☐ ADVANCED SUCCESSIONAL GROWTH

11c. GROUND COVER: ☒ GRASS ☐ VINES ☐ BRUSH, DECIDUOUS ☐ BRUSH, CONIF.

☐ MIXED _____

PERCENT COVER: ☐ 0 ☐ 0-25 ☐ 26-50 ☒ 51-75 ☐ 76-100

GENERAL HEIGHT: FT. 1/2'

11d CHARACTERISTIC CANOPY OR SHRUB HEIGHT, FT

☒ 0-3 ☐ 3-8 ☐ 9-13 ☐ 14-30 ☐ 31-62 ☐ 63-95 ☐ 96-164 ☐ >164

11e. CANOPY CLOSURE, PERCENT

☐ <25 ☐ 26-50 ☐ 51-75 ☒ 76-100

REMARKS Heights of oaks (Ø 12") = 75'
(& " pines (Ø 20") = 90'

11f. FOR ROW-PLANTED TREES (ONLY)

Mean Row Spacing, ft ____

Compass Direction Magnetic Azimuth ____ °

		0	1	2	3	4	5	6	7	8	9	10
ROW SAMPLE	STA											
	FT											
	BHD											

SITE NO: 68 SHEET 5 of 15 DATE: 1/8/79

12. TREE STEM SIZE/SPACING (Standing Trees)

Stem Diam Class	Stem Diam, in.	Number of Stems Coniferous (C)	Deciduous (D)	(C + D)	Sample Cell Diam, ft
1	<1				
2	1				
	1.5				
	2				
3	2.5				
	3		8		
	3.5				
4	4				
	4.5				
	5				
	5.5				
5	6		4		
	6.5				
	7		4		
6	7.5				
	8		8		
	8.5				
7	9				
	9.5				
8	10-15		80		
	15.5-20		4		
	20-30	8			
	30-40				
	40-60				
	60-100				
	100				

200'

ESTIMATED DIST TO NEXT TREE OF LARGEST SIZE ABOVE, FT

$D_A = \sqrt{8\times3^2+4\times6^2+\cdots+8\times25^2/116} = 13.0''$ $SS_A = \frac{D}{\sqrt{n}} = \frac{200}{\sqrt{116}} = 18.6$

SITE NO: 86 DATE: 1/8/79

11. GENERAL FOREST DESCRIPTION

☐ NO FOREST (GO TO BLOCK 13) ☒ CONIFEROUS ☐ DECIDUOUS ☐ MIXED

APPROXIMATE COMPOSITION

	COMMON NAME	APPROX. PERCENT OF STEMS					
		100	75-99	50-74	26-50	10-25	<10
1	beech	☐	☐	☐	☐	☐	☒
2	pines	☐	☒	☐	☐	☐	☐
3	larch	☐	☐	☐	☐	☒	☐

11a. MANAGEMENT

☐ INDETERMINATE ☐ NATURAL ☒ NATURAL, MANAGED ☐ THINNED

☐ SEEDED, BROADCAST ☐ ROW-PLANTED ☐ _____

11b. GROWTH STAGE

☐ INDETERMINATE ☐ MATURE

FOR SEEDED/PLANTED FOREST: ☐ RECENTLY REPLANTED ☒ INTERMEDIATE

FOR NATURAL FOREST: ☐ EARLY SECOND GROWTH ☐ ADVANCED SUCCESSIONAL GROWTH

11c. GROUND COVER: ☐ GRASS ☐ VINES ☐ BRUSH, DECIDUOUS ☒ BRUSH, CONIF.

☐ MIXED _____

PERCENT COVER: ☐ 0 ☐ 0-25 ☐ 26-50 ☐ 51-75 ☒ 76-100

GENERAL HEIGHT: FT. /

11d CHARACTERISTIC CANOPY OR SHRUB HEIGHT, FT

☒ 0-3 ☐ 3-8 ☐ 9-13 ☐ 14-30 ☐ 31-62 ☐ 63-95 ☐ 96-164 ☐ >164

11e. CANOPY CLOSURE, PERCENT

☐ <25 ☐ 26-50 ☐ 51-75 ☒ 76-100

REMARKS Heights of pines (ϕ 2-5") = 45'

" " larches (ϕ 2-5") = 45'

11f. FOR ROW-PLANTED TREES (ONLY)

		Mean Row Spacing, ft 0	1	2	3	4	5	6	7	8	9	Compass Direction Magnetic Azimuth ° 10
ROW SAMPLE	STA FT											
	BRD											

SITE NO: 86 AT SHEET 5 of 15 DATE: 1/8/79

12. TREE STEM SIZE/SPACING (Standing Trees)

Stem Diam Class	Stem Diam, in.	Number of Stems			Sample Cell Diam, ft
		Coniferous (C)	Deciduous (D)	(C + D)	
1	≤1				
2	1	1			
	1.5				
	2	19	30		
3	2.5				
	3	20			
	3.5				
4	4	24			
	4.5				
	5	37			
	5.5				
5	6	13			
	6.5				
	7	8			
6	7.5				
	8	1			
	8.5				
7	9				
	9.5				
8	10-15	2			
	15.5-20				
	20-30				
	30-40				
	40-60				
	60-100				
	100				

100'

ESTIMATED DIST TO NEXT TREE OF LARGEST SIZE ABOVE, FT

$D_A = \sqrt{1\times12 + 49\times2^2 + \cdots + 2\times12.5^2/155} = 4.3'$ $SS_A = \frac{100}{\sqrt{155}} = 8.0'$

SITE NO: 87 DATE: 7/18/79

11. GENERAL FOREST DESCRIPTION

☐ NO FOREST (GO TO BLOCK 13) ☒ CONFIEROUS ☐ DECIDUOUS ☐ MIXED

APPROXIMATE COMPOSITION

	COMMON NAME	APPROX. PERCENT OF STEMS					
		☐ 100	☐ 75-99	☒ 50-74	☐ 26-50	☐ 10-25	☐ <10
1	pine						
2	spruce	☐	☐	☐	☒	☐	☐
3	beech	☐	☐	☐	☐	☒	☐

11a. MANAGEMENT

☐ INDETERMINATE ☐ NATURAL ☒ NATURAL, MANAGED ☐ THINNED

☐ SEEDED, BROADCAST ☐ ROW-PLANTED ☐ _____

11b. GROWTH STAGE

☐ INDETERMINATE ☒ MATURE

FOR SEEDED/PLANTED FOREST: ☐ RECENTLY REPLANTED ☐ INTERMEDIATE

FOR NATURAL FOREST: ☐ EARLY SECOND GROWTH ☐ ADVANCED SUCCESSIONAL GROWTH

11c. GROUND COVER: ☐ GRASS ☐ VINES ☐ BRUSH, DECIDUOUS ☒ BRUSH, CONIF.

☐ MIXED _____

PERCENT COVER: ☐ 0 ☐ 0-25 ☐ 26-50 ☒ 51-75 ☐ 76-100

GENERAL HEIGHT: FT. 2

11d CHARACTERISTIC CANOPY OR SHRUB HEIGHT, FT

☐ 0-3 ☒ 3-8 ☐ 9-13 ☐ 14-30 ☐ 31-62 ☐ 63-95 ☐ 96-164 ☐ >164

11e. CANOPY CLOSURE, PERCENT

☐ <25 ☐ 26-50 ☐ 51-75 ☒ 76-100

REMARKS Heights of pines (Ø15-18") = 90'

" " spruces (Ø15-18") = 95'

11f. FOR ROW-PLANTED TREES (ONLY)

		Mean Row Spacing, ft 0	1	2	3	4	5	6	7	8	9	Compass Direction Magnetic Azimuth ° 10
ROW SAMPLE	STA FT											
	BRD											

12. TREE STEM SIZE/SPACING (Standing Trees)

Stem Diam Class	Stem Diam, in.	Number of Stems Coniferous (C)	Deciduous (D)	(C + D)	Sample Cell Diam, ft
1	≤1				
2	1				
	1.5				
	2				
3	2.5				
	3				
	3.5				
4	4	8	4		
	4.5				
	5		12		
	5.5				
5	6				
	6.5				
	7	4	4		
6	7.5				
	8	4			
	8.5				
7	9		4		
	9.5				
8	10-15	60	16		
	15.5-20	10			
	20-30	6			
	30-40				
	40-60				
	60-100				
	100				

200'

ESTIMATED DIST TO NEXT TREE OF LARGEST SIZE ABOVE, FT _____

$D_A = 12.4''$ $SS_A = 17.4'$

SITE NO: 3 DATE: 2/8/79

11. GENERAL FOREST DESCRIPTION

☐ NO FOREST (GO TO BLOCK 13) ☐ CONFIEROUS ☒ DECIDUOUS ☐ MIXED

APPROXIMATE COMPOSITION

	COMMON NAME	APPROX. PERCENT OF STEMS					
		☐ 100	☒ 75-99	☐ 50-74	☐ 26-50	☐ 10-25	☐ <10
1	beech						
2	oak	☐	☐	☐	☐	☒	☐
3		☐	☐	☐	☐	☐	☐

11a. MANAGEMENT

☐ INDETERMINATE ☐ NATURAL ☒ NATURAL, MANAGED ☐ THINNED

☐ SEEDED, BROADCAST ☐ ROW-PLANTED ☐ _____

11b. GROWTH STAGE

☐ INDETERMINATE ☐ MATURE

FOR SEEDED/PLANTED FOREST: ☐ RECENTLY REPLANTED ☒ INTERMEDIATE

FOR NATURAL FOREST: ☐ EARLY SECOND GROWTH ☐ ADVANCED SUCCESSIONAL GROWTH

11c. GROUND COVER: ☐ GRASS ☒ VINES ☐ BRUSH, DECIDUOUS ☐ BRUSH, CONIF.

☐ MIXED _____

PERCENT COVER: ☐ 0 ☐ 0-25 ☐ 26-50 ☐ 51-75 ☐ 76-100

GENERAL HEIGHT: FT. 1/2'

11d CHARACTERISTIC CANOPY OR SHRUB HEIGHT, FT

☒ 0-3 ☐ 3-8 ☐ 9-13 ☐ 14-30 ☐ 31-62 ☐ 63-95 ☐ 96-164 ☐ >164

11e. CANOPY CLOSURE, PERCENT

☐ <25 ☐ 26-50 ☐ 51-75 ☒ 76-100

REMARKS Heights of beech (Ø12-14") = 54'
oak (Ø7-10") = 50'

11f. FOR ROW-PLANTED TREES (ONLY)

Mean Row Spacing, ft ___ Compass Direction Magnetic Azimuth ___ °

		0	1	2	3	4	5	6	7	8	9	10
ROW SAMPLE	STA											
	FT											
	BRD											

SITE NO: 3 AT SHEET 5 of 15 DATE: 2/8/79

12. TREE STEM SIZE/SPACING (Standing Trees)

Stem Diam Class	Stem Diam, in.	Number of Stems			Sample Cell Diam, ft
		Coniferous (C)	Deciduous (D)	(C + D)	
1	<1				
2	1				
	1.5				
	2				
3	2.5				
	3		8		
	3.5				
4	4		16		
	4.5				
	5		17		
	5.5				
5	6		4		
	6.5				
	7		4		
6	7.5				
	8		8		
	8.5				
7	9		8		
	9.5				
8	10-15		80		
	15.5-20		3		
	20-30				
	30-40				
	40-60				
	60-100				
	100				

200'

ESTIMATED DIST TO NEXT TREE OF LARGEST SIZE ABOVE, FT _____

$D_A = 10.3''$ $SS_A = 16.4'$

SITE NO: 4 DATE: 2/8/79

11. GENERAL FOREST DESCRIPTION

☐ NO FOREST (GO TO BLOCK 13) ☐ CONFIEROUS ☒ DECIDUOUS ☐ MIXED

APPROXIMATE COMPOSITION

	COMMON NAME	APPROX. PERCENT OF ITEMS					
		☐ 100	☐ 75-99	☒ 50-74	☐ 26-50	☐ 10-25	☐ <10
1	oak						
2	beech	☐	☐	☐	☒	☐	☐
3		☐	☐	☐	☐	☐	☐

11a. MANAGEMENT

☐ INDETERMINATE ☐ NATURAL ☒ NATURAL, MANAGED ☐ THINNED

☐ SEEDED, BROADCAST ☐ ROW-PLANTED ☐ _____

11b. GROWTH STAGE

☐ INDETERMINATE ☐ MATURE

FOR SEEDED/PLANTED FOREST: ☐ RECENTLY REPLANTED ☒ INTERMEDIATE

FOR NATURAL FOREST: ☐ EARLY SECOND GROWTH ☐ ADVANCED SUCCESSIONAL GROWTH

11c. GROUND COVER: ☒ GRASS ☐ VINES ☐ BRUSH, DECIDUOUS ☐ BRUSH, CONIF.

☐ MIXED _____

PERCENT COVER: ☐ 0 ☐ 0-25 ☐ 26-50 ☐ 51-75 ☒ 76-100

GENERAL HEIGHT: FT. 1'

11d CHARACTERISTIC CANOPY OR SHRUB HEIGHT, FT

☐ 0-3 ☒ 3-8 ☐ 9-13 ☐ 14-30 ☐ 31-62 ☐ 63-95 ☐ 96-164 ☐ >164

11e. CANOPY CLOSURE, PERCENT

☐ <25 ☐ 26-50 ☐ 51-75 ☒ 76-100

REMARKS Heights of oaks (Ø8-10") = 40'
" " beeches (Ø6") = 40'

11f. FOR ROW-PLANTED TREES (ONLY)

Mean Row Spacing, ft ___ Compass Direction Magnetic Azimuth ___ °

ROW SAMPLE	0	1	2	3	4	5	6	7	8	9	10
STA FT											
DBH											

12. TREE STEM SIZE/SPACING (Standing Trees)

Stem Diam Class	Stem Diam, in.	Number of Stems			Sample Cell Diam, ft
		Coniferous (C)	Deciduous (D)	(C + D)	
1	<1				
2	1		4		
	1.5				
	2		6		
3	2.5				
	3		3		
	3.5				
4	4		4		
	4.5				
	5		3		
	5.5				
5	6		6		
	6.5				
	7		1		
6	7.5				
	8		13		
	8.5				
7	9		2		
	9.5				
8	10-15		9		
	15.5-20				
	20-30				
	30-40				
	40-60				
	60-100				
	100				

55'

ESTIMATED DIST TO NEXT TREE OF LARGEST SIZE ABOVE, FT _____

$D_A = 7.5''$ $SS_A = 7.7'$

SITE NO: 5 DATE: 2/8/79

11. GENERAL FOREST DESCRIPTION

☐ NO FOREST (GO TO BLOCK 13) ☐ CONFIEROUS ☒ DECIDUOUS ☐ MIXED

APPROXIMATE COMPOSITION

	COMMON NAME	APPROX. PERCENT OF STEMS					
		100	75-99	50-74	26-50	10-25	<10
1	beech	☒	☐	☐	☐	☐	☐
2		☐	☐	☐	☐	☐	☐
3		☐	☐	☐	☐	☐	☐

11a. MANAGEMENT

☐ INDETERMINATE ☐ NATURAL ☒ NATURAL, MANAGED ☐ THINNED

☐ SEEDED, BROADCAST ☐ ROW-PLANTED ☐ _____

11b. GROWTH STAGE

☐ INDETERMINATE ☒ MATURE

FOR SEEDED/PLANTED FOREST: ☐ RECENTLY REPLANTED ☐ INTERMEDIATE

FOR NATURAL FOREST: ☐ EARLY SECOND GROWTH ☐ ADVANCED SUCCESSIONAL GROWTH

11c. GROUND COVER: ☒ GRASS ☐ VINES ☐ BRUSH, DECIDUOUS ☐ BRUSH, CONIF.

☐ MIXED _____

PERCENT COVER: ☐ 0 ☐ 0-25 ☐ 26-50 ☐ 51-75 ☒ 76-100

GENERAL HEIGHT: FT. 1'

11d CHARACTERISTIC CANOPY OR SHRUB HEIGHT, FT

☐ 0-3 ☒ 3-8 ☐ 9-13 ☐ 14-30 ☐ 31-62 ☐ 63-95 ☐ 96-164

☐ >164

11e. CANOPY CLOSURE, PERCENT

☐ <25 ☐ 26-50 ☐ 51-75 ☒ 76-100

REMARKS Heights of beeches (ø 17") = 105'

11f. FOR ROW-PLANTED TREES (ONLY)

		Mean Row Spacing, ft ___										Compass Direction Magnetic Azimuth ___ °
		0	1	2	3	4	5	6	7	8	9	10
ROW SAMPLE	STA											
	FT											
	BRD											

SITE NO: 5 AT SHEET 5 of 15 DATE: 2/8/79

12. TREE STEM SIZE/SPACING (Standing Trees)

Stem Diam Class	Stem Diam, in.	Number of Stems			Sample Cell Diam, ft
		Coniferous (C)	Deciduous (D)	(C + D)	
1	<1				
2	1				
	1.5				
	2				
3	2.5				
	3				
	3.5				
4	4				
	4.5				
	5				
	5.5				
5	6				
	6.5				
	7				
6	7.5				
	8				
	8.5				
7	9				
	9.5				
8	10-15				
	15.5-20		60		
	20-30				
	30-40				
	40-60				
	60-100				
	100				

200'

ESTIMATED DIST TO NEXT TREE OF LARGEST SIZE ABOVE, FT _____

D_A = 17.75" SS_A = 25.8'

SITE NO: 10 DATE: 2/8/79

11. GENERAL FOREST DESCRIPTION

☐ NO FOREST (GO TO BLOCK 13) ☐ CONFIEROUS ☒ DECIDUOUS ☐ MIXED

APPROXIMATE COMPOSITION

	COMMON NAME	APPROX. PERCENT OF STEMS					
		☐ 100	☒ 75-99	☐ 50-74	☐ 26-50	☐ 10-25	☐ <10
1	oak						
2	larch	☐	☐	☐	☐	☒	☐
3		☐	☐	☐	☐	☐	☐

11a. MANAGEMENT

☐ INDETERMINATE ☐ NATURAL ☒ NATURAL, MANAGED ☐ THINNED

☐ SEEDED, BROADCAST ☐ ROW-PLANTED ☐ _____

11b. GROWTH STAGE

☐ INDETERMINATE ☐ MATURE

FOR SEEDED/PLANTED FOREST: ☐ RECENTLY REPLANTED ☐ INTERMEDIATE

FOR NATURAL FOREST: ☒ EARLY SECOND GROWTH ☐ ADVANCED SUCCESSIONAL GROWTH

11c. GROUND COVER: ☐ GRASS ☒ VINES ☐ BRUSH, DECIDUOUS ☐ BRUSH, CONIF.

☐ MIXED _____

PERCENT COVER: ☐ 0 ☐ 0-25 ☐ 26-50 ☐ 51-75 ☒ 76-100

GENERAL HEIGHT: FT. 1/2'

11d CHARACTERISTIC CANOPY OR SHRUB HEIGHT, FT

☒ 0-3 ☐ 3-8 ☐ 9-13 ☐ 14-30 ☐ 31-62 ☐ 63-95 ☐ 96-164

☐ >164

11e. CANOPY CLOSURE, PERCENT

☐ <25 ☐ 26-50 ☐ 51-75 ☒ 76-100

REMARKS Heights of oaks (ø5") = 45'

" " larches (ø4") = 45'

11f. FOR ROW-PLANTED TREES (ONLY)

		Mean Row Spacing, ft ___										Compass Direction Magnetic Azimuth ___ °
		0	1	2	3	4	5	6	7	8	9	10
ROW SAMPLE	STA FT											
	DBH											

12. TREE STEM SIZE/SPACING (Standing Trees)

Stem Diam Class	Stem Diam, in.	Number of Stems			Sample Cell Diam, ft
		Coniferous (C)	Deciduous (D)	(C + D)	
1	<1				
2	1				
	1.5				
	2		4		
3	2.5				
	3	20	36		
	3.5				
4	4	32	44		
	4.5				
	5	15	74		
	5.5				
5	6				
	6.5				
	7		4		
6	7.5				
	8				
	8.5				
7	9				
	9.5				
8	10-15				
	15.5-20				
	20-30				
	30-40				
	40-60				
	60-100				
	100				

100'

ESTIMATED DIST TO NEXT TREE OF LARGEST SIZE ABOVE, FT _____

$D_A = 4.3''$ $SS_A = 6.6'$

SITE NO: 12 DATE: 2/8/79

11. GENERAL FOREST DESCRIPTION

☐ NO FOREST (GO TO BLOCK 13) ☒ CONFIEROUS ☐ DECIDUOUS ☐ MIXED

APPROXIMATE COMPOSITION

	COMMON NAME	APPROX. PERCENT OF STEMS					
		100	75-99	50-74	26-50	10-25	<10
1	Spruce	☒	☐	☐	☐	☐	☐
2		☐	☐	☐	☐	☐	☐
3		☐	☐	☐	☐	☐	☐

11a. MANAGEMENT

☐ INDETERMINATE ☐ NATURAL ☒ NATURAL, MANAGED ☐ THINNED

☐ SEEDED, BROADCAST ☐ ROW-PLANTED ☐ _____

11b. GROWTH STAGE

☐ INDETERMINATE ☐ MATURE

FOR SEEDED/PLANTED FOREST: ☐ RECENTLY REPLANTED ☐ INTERMEDIATE

FOR NATURAL FOREST: ☐ EARLY SECOND GROWTH ☒ ADVANCED SUCCESSIONAL GROWTH

11c. GROUND COVER: ☐ GRASS ☐ VINES ☐ BRUSH, DECIDUOUS ☒ BRUSH, CONIF.

☐ MIXED _____

PERCENT COVER: ☐ 0 ☐ 0-25 ☐ 26-50 ☐ 51-75 ☒ 76-100

GENERAL HEIGHT: FT. 1/2'

11d CHARACTERISTIC CANOPY OR SHRUB HEIGHT, FT

☒ 0-3 ☐ 3-8 ☐ 9-13 ☐ 14-30 ☐ 31-62 ☐ 63-95 ☐ 96-164

☐ >164

11e. CANOPY CLOSURE, PERCENT

☐ <25 ☐ 26-50 ☐ 51-75 ☒ 76-100

REMARKS Heights of Spruces (ø 10') = 74'

11f. FOR ROW-PLANTED TREES (ONLY)

Compass Direction Magnetic Azimuth ___ °

		Mean Row Spacing, ft 0	1	2	3	4	5	6	7	8	9	10
ROW SAMPLE	STA											
	FT											
	BRD											

SITE NO: 12 AT SHEET 5 of 15 DATE: 2/8/79

12. TREE STEM SIZE/SPACING (Standing Trees)

Stem Diam Class	Stem Diam, in.	Number of Stems			Sample Cell Diam, ft
		Coniferous (C)	Deciduous (D)	(C + D)	
1	≤1				
2	1				
	1.5				
	2				
3	2.5				
	3				
	3.5				
4	4				
	4.5				
	5	8			
	5.5				
5	6				
	6.5				
	7	12			
6	7.5				
	8	23			
	8.5				
7	9	48			
	9.5				
8	10-15	96			
	15.5-20				
	20-30				
	30-40				
	40-60				
	60-100				
	100				

200'

ESTIMATED DIST TO NEXT TREE OF LARGEST SIZE ABOVE, FT _____

D_A = 10.6" SS_A = 14.6'

SITE NO: 14 DATE: 2/8/79

11. GENERAL FOREST DESCRIPTION

☐ NO FOREST (GO TO BLOCK 13) ☒ CONFIEROUS ☐ DECIDUOUS ☐ MIXED

APPROXIMATE COMPOSITION

	COMMON NAME	APPROX. PERCENT OF STEMS					
		100	75-99	50-74	26-50	10-25	<10
1	pine	☒	☐	☐	☐	☐	☐
2		☐	☐	☐	☐	☐	☐
3		☐	☐	☐	☐	☐	☐

11a. MANAGEMENT

☐ INDETERMINATE ☐ NATURAL ☒ NATURAL, MANAGED ☐ THINNED

☐ SEEDED, BROADCAST ☐ ROW-PLANTED ☐ _____

11b. GROWTH STAGE

☐ INDETERMINATE ☒ MATURE

FOR SEEDED/PLANTED FOREST: ☐ RECENTLY REPLANTED ☐ INTERMEDIATE

FOR NATURAL FOREST: ☐ EARLY SECOND GROWTH ☐ ADVANCED SUCCESSIONAL GROWTH

11c. GROUND COVER: ☐ GRASS ☐ VINES ☐ BRUSH, DECIDUOUS ☐ BRUSH, CONIF.

☐ MIXED blueberries

PERCENT COVER: ☐ 0 ☐ 0-25 ☐ 26-50 ☐ 51-75 ☒ 76-100

GENERAL HEIGHT: FT. 1'

11d CHARACTERISTIC CANOPY OR SHRUB HEIGHT, FT

☐ 0-3 ☐ 3-8 ☒ 9-13 ☐ 14-30 ☐ 31-62 ☐ 63-95 ☐ 96-164

☐ >164

11e. CANOPY CLOSURE, PERCENT

☐ <25 ☐ 26-50 ☒ 51-75 ☐ 76-100

REMARKS Heights of pines (6-12") = 7-2'

11f. FOR ROW-PLANTED TREES (ONLY)

Mean Row Spacing, ft ____

Compass Direction Magnetic Azimuth ____ °

ROW SAMPLE		0	1	2	3	4	5	6	7	8	9	10
	STA FT											
	BHD											

SITE NO: 14 AT SHEET 5 of 15 DATE: 2/8/79

12. TREE STEM SIZE/SPACING (Standing Trees)

Stem Diam Class	Stem Diam., in.	Number of Stems			Sample Cell Diam, ft
		Coniferous (C)	Deciduous (D)	(C + D)	
1	<1				
2	1				
	1.5				
	2				
3	2.5				
	3				
	3.5				
4	4	4			
	4.5				
	5	4			
	5.5				
5	6	44			
	6.5				
	7	48			
6	7.5				
	8	44			
	8.5				
7	9	48			
	9.5				
8	10-15	80			
	15.5-20				
	20-30				
	30-40				
	40-60				
	60-100				
	100				

200'

ESTIMATED DIST TO NEXT TREE OF LARGEST SIZE ABOVE, FT _____

$D_A = 9.3''$ $SS_A = 12.1'$

SITE NO: 16 DATE: 2/8/79

11. GENERAL FOREST DESCRIPTION

☐ NO FOREST (GO TO BLOCK 13) ☒ CONFIEROUS ☐ DECIDUOUS ☐ MIXED

APPROXIMATE COMPOSITION

	COMMON NAME	APPROX. PERCENT OF STEMS					
		100	75-99	50-74	26-50	10-25	<10
1	pine	☒	☐	☐	☐	☐	☐
2		☐	☐	☐	☐	☐	☐
3		☐	☐	☐	☐	☐	☐

11a. MANAGEMENT

☐ INDETERMINATE ☐ NATURAL ☒ NATURAL, MANAGED ☐ THINNED

☐ SEEDED, BROADCAST ☐ ROW-PLANTED ☐ _____

11b. GROWTH STAGE

☐ INDETERMINATE ☐ MATURE

FOR SEEDED/PLANTED FOREST: ☐ RECENTLY REPLANTED ☐ INTERMEDIATE

FOR NATURAL FOREST: ☒ EARLY SECOND GROWTH ☐ ADVANCED SUCCESSIONAL GROWTH

11c. GROUND COVER: ☐ GRASS ☐ VINES ☐ BRUSH, DECIDUOUS ☒ BRUSH, CONIF.

☐ MIXED _____

PERCENT COVER: ☐ 0 ☐ 0-25 ☐ 26-50 ☐ 51-75 ☒ 76-100

GENERAL HEIGHT: FT. 1'

11d CHARACTERISTIC CANOPY OR SHRUB HEIGHT, FT

☐ 0-3 ☒ 3-8 ☐ 9-13 ☐ 14-30 ☐ 31-62 ☐ 63-95 ☐ 96-164

☐ >164

11e. CANOPY CLOSURE, PERCENT

☐ <25 ☐ 26-50 ☐ 51-75 ☒ 76-100

REMARKS Heights of Pines (ϕ 5") = 36'

11f. FOR ROW-PLANTED TREES (ONLY)

		Mean Row Spacing, ft ___										Compass Direction Magnetic Azimuth ___ °
		0	1	2	3	4	5	6	7	8	9	10
ROW SAMPLE	STA FT											
	BRD											

SITE NO: 16 AT SHEET 5 of 15
DATE: 2/8/79

12. TREE STEM SIZE/SPACING (Standing Trees)

Stem Diam Class	Stem Diam, in.	Number of Stems			Sample Cell Diam, ft
		Coniferous (C)	Deciduous (D)	(C + D)	
1	<1				
2	1				
	1.5				
	2	12			
3	2.5				
	3	12			
	3.5				
4	4	40			
	4.5				
	5	85			
	5.5				
5	6	24			
	6.5				
	7	4			
6	7.5				
	8				
	8.5				
7	9				
	9.5				
8	10-15				
	15.5-20				
	20-30				
	30-40				
	40-60				
	60-100				
	100				

100'

ESTIMATED DIST TO NEXT TREE OF LARGEST SIZE ABOVE, FT _____

$D_A = 4.7''$ $SS_A = 7.5'$

SITE NO: 17 DATE: 2/8/79

11. GENERAL FOREST DESCRIPTION

☐ NO FOREST (GO TO BLOCK 13) ☒ CONFIEROUS ☐ DECIDUOUS ☐ MIXED

APPROXIMATE COMPOSITION

	COMMON NAME	APPROX. PERCENT OF STEMS					
1	pine	☒ 100	☐ 75-99	☐ 50-74	☐ 26-50	☐ 10-25	☐ <10
2		☐	☐	☐	☐	☐	☐
3		☐	☐	☐	☐	☐	☐

11a. MANAGEMENT

☐ INDETERMINATE ☐ NATURAL ☒ NATURAL, MANAGED ☐ THINNED

☐ SEEDED, BROADCAST ☐ ROW-PLANTED ☐ _____

11b. GROWTH STAGE

☐ INDETERMINATE ☒ MATURE

FOR SEEDED/PLANTED FOREST: ☐ RECENTLY REPLANTED ☐ INTERMEDIATE

FOR NATURAL FOREST: ☐ EARLY SECOND GROWTH ☐ ADVANCED SUCCESSIONAL GROWTH

11c. GROUND COVER: ☐ GRASS ☐ VINES ☐ BRUSH, DECIDUOUS ☐ BRUSH, CONIF.

☐ MIXED blueberries

PERCENT COVER: ☐ 0 ☐ 0-25 ☐ 26-50 ☐ 51-75 ☒ 76-100

GENERAL HEIGHT: FT. 1'

11d CHARACTERISTIC CANOPY OR SHRUB HEIGHT, FT

☐ 0-3 ☐ 3-8 ☒ 9-13 ☐ 14-30 ☐ 31-62 ☐ 63-95 ☐ 96-164 ☐ >164

11e. CANOPY CLOSURE, PERCENT

☐ <25 ☐ 26-50 ☒ 51-75 ☐ 76-100

REMARKS Height of pines (Ø12") = 78'

11f. FOR ROW-PLANTED TREES (ONLY)

Compass Direction Magnetic Azimuth ___ °

		Mean Row Spacing, ft 0	1	2	3	4	5	6	7	8	9	10
ROW SAMPLE	STA FT											
	BRD											

SITE NO: 17 - A 45 - AT SHEET 5 of 15 DATE: 2/8/79

12. TREE STEM SIZE/SPACING (Standing Trees)

Stem Diam Class	Stem Diam, in.	Number of Stems			Sample Cell Diam, ft
		Coniferous (C)	Deciduous (D)	(C + D)	
1	<1				
2	1				
	1.5				
	2				
3	2.5				
	3				
	3.5				
4	4				
	4.5				
	5	4			
	5.5				
5	6	4			
	6.5				
	7	8			
6	7.5				
	8				
	8.5				
7	9				
	9.5				
8	10-15	120			
	15.5-20	4			
	20-30				
	30-40				
	40-60				
	60-100				
	100				

200'

ESTIMATED DIST TO NEXT TREE OF LARGEST SIZE ABOVE, FT _____

$D_A = 12.1''$ $SS_A = 16.9'$

SITE NO: 20 DATE: 2/8/79

11. GENERAL FOREST DESCRIPTION

☐ NO FOREST (GO TO BLOCK 13) ☒ CONFIEROUS ☐ DECIDUOUS ☐ MIXED

APPROXIMATE COMPOSITION

	COMMON NAME	APPROX. PERCENT OF STEMS					
		100	75-99	50-74	26-50	10-25	<10
1	pine	☒	☐	☐	☐	☐	☐
2		☐	☐	☐	☐	☐	☐
3		☐	☐	☐	☐	☐	☐

11a. MANAGEMENT

☐ INDETERMINATE ☐ NATURAL ☒ NATURAL, MANAGED ☐ THINNED

☐ SEEDED, BROADCAST ☐ ROW-PLANTED ☐ _____

11b. GROWTH STAGE

☐ INDETERMINATE ☒ MATURE

FOR SEEDED/PLANTED FOREST: ☐ RECENTLY REPLANTED ☐ INTERMEDIATE

FOR NATURAL FOREST: ☐ EARLY SECOND GROWTH ☐ ADVANCED SUCCESSIONAL GROWTH

11c. GROUND COVER: ☐ GRASS ☐ VINES ☐ BRUSH, DECIDUOUS ☐ BRUSH, CONIF

☐ MIXED blueberries

PERCENT COVER: ☐ 0 ☐ 0-25 ☐ 26-50 ☐ 51-75 ☒ 76-100

GENERAL HEIGHT: FT. 1'

11d CHARACTERISTIC CANOPY OR SHRUB HEIGHT, FT

☐ 0-3 ☒ 3-8 ☐ 9-13 ☐ 14-30 ☐ 31-62 ☐ 63-95 ☐ 96-164

☐ >164

11e. CANOPY CLOSURE, PERCENT

☐ <25 ☐ 26-50 ☒ 51-75 ☐ 76-100

REMARKS Height of pines (ø 12-14") = 50'

11f. FOR ROW-PLANTED TREES (ONLY)

		Mean Row Spacing, ft ___ 0	1	2	3	4	5	6	7	8	9	Compass Direction Magnetic Azimuth ___° 10
ROW SAMPLE	STA FT											
	BRD											

12. TREE STEM SIZE/SPACING (Standing Trees)

Stem Diam Class	Stem Diam, in.	Number of Stems Coniferous (C)	Deciduous (D)	(C + D)	Sample Cell Diam, ft
1	<1				
2	1				
	1.5				
	2				
3	2.5				
	3				
	3.5				
4	4				
	4.5				
	5				
	5.5				
5	6				
	6.5				
	7				
6	7.5				
	8	12			
	8.5				
7	9				
	9.5				
8	10-15	120			
	15.5-20	8			
	20-30	4			
	30-40				
	40-60				
	60-100				
	100				

200'

ESTIMATED DIST TO NEXT TREE OF LARGEST SIZE ABOVE, FT _____

$D_A = 13''$ $SS_A = 16.7'$

SITE NO: 31 DATE: 2/8/79

11. GENERAL FOREST DESCRIPTION

☐ NO FOREST (GO TO BLOCK 13) ☒ CONIFEROUS ☐ DECIDUOUS ☐ MIXED

APPROXIMATE COMPOSITION

	COMMON NAME	APPROX. PERCENT OF STEMS					
1	Spruce	☒ 100	☐ 75-99	☐ 50-74	☐ 26-50	☐ 10-25	☐ <10
2		☐	☐	☐	☐	☐	☐
3		☐	☐	☐	☐	☐	☐

11a. MANAGEMENT

☐ INDETERMINATE ☐ NATURAL ☒ NATURAL, MANAGED ☐ THINNED

☐ SEEDED, BROADCAST ☐ ROW-PLANTED ☐ _____

11b. GROWTH STAGE

☒ INDETERMINATE ☐ MATURE

FOR SEEDED/PLANTED FOREST: ☐ RECENTLY REPLANTED ☒ INTERMEDIATE

FOR NATURAL FOREST: ☐ EARLY SECOND GROWTH ☐ ADVANCED SUCCESSIONAL GROWTH

11c. GROUND COVER: ☐ GRASS ☐ VINES ☐ BRUSH, DECIDUOUS ☒ BRUSH, CONIF ☐ MIXED _____

PERCENT COVER: ☐ 0 ☐ 0-25 ☐ 26-50 ☐ 51-75 ☒ 76-100

GENERAL HEIGHT: FT. 1/2'

11d CHARACTERISTIC CANOPY OR SHRUB HEIGHT, FT

☐ 0-3 ☒ 3-8 ☐ 9-13 ☐ 14-30 ☐ 31-62 ☐ 63-95 ☐ 96-164 ☐ >164

11e. CANOPY CLOSURE, PERCENT

☐ <25 ☐ 26-50 ☐ 51-75 ☒ 76-100

REMARKS Heights of Spruces (5-12") = 75'

11f. FOR ROW-PLANTED TREES (ONLY)

Mean Row Spacing, ft ____ Compass Direction Magnetic Azimuth ____ °

ROW SAMPLE	0	1	2	3	4	5	6	7	8	9	10
STA											
FT											
BRD											

SITE NO: 31 - A 49 - AT SHEET 5 of 15 DATE: 2/8/79

12. TREE STEM SIZE/SPACING (Standing Trees)

Stem Diam Class	Stem Diam, in.	Number of Stems			Sample Cell Diam, ft
		Coniferous (C)	Deciduous (D)	(C + D)	
1	<1				
2	1				
	1.5				
	2				
3	2.5				
	3				
	3.5				
4	4				
	4.5				
	5	14			
	5.5				
5	6	8			
	6.5				
	7	20			
6	7.5				
	8	10			
	8.5				
7	9	12			
	9.5				
8	10-15	3			
	15.5-20				
	20-30				
	30-40				
	40-60				
	60-100				
	100				

601

ESTIMATED DIST TO NEXT TREE OF LARGEST SIZE ABOVE, FT _____

$D_A = 7.4''$ $SS_A = 7.3'$

APPENDIX L: Summary of Definitions of Forestry Terms

Locality class

Locality classes evaluate the general growth in height and thickness of trees and range from class I (extremely good conditions) to class VI (extremely bad).

Thinning

Thinning fosters growth of best trees (positive selection) or removes ill ones (negative selection) in order to control volume yield of stands.

Method of thinning

Methods of thinning are split into moderate and heavy thinning and are not quantitatively specified within forestry guidelines. Application depends on numerous individual site factors. Generally, heavy thinning raises the average stem diameter for all species for 1 to 1.5 inches.

Type of thinning

Types of thinning are split into low, high and plenter thinning. Low thinning aims at a single-storied stand, while high thinning aims at an even-aged multy-story stand. Plenter thinning results in even-sized and even-height stands.

Average tree height

Average height describes the height to top of trees for a sample area.

Dominant height

Dominant height or top height describes the height to top of trees for the 50 thickest trees of a sample area. It applies to such speices where extreme height growth variations occur (beech, japanese larch, douglas fir, sitka).

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